TOWARDS A NATIONAL POLICY

FOR

A COMPUTER-ASSISTED LEARNING INDUSTRY

ASSOCIATE COMMITTEE ON INSTRUCTIONAL TECHNOLOGY

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Foreword

The Associate Committee on Instructional Technology was formed in 1969. Its members are experts in the various disciplines related to instructional technology and are selected so that regional requirements and resources are best represented. In general, the term INSTRUCTIONAL TECHNOLOGY, insofar as it applies to Committee activities, is taken to mean those communication media which can be used for instructional purposes. Within this general framework, the primary focus is on the application of the computer and its interaction with other media. Specific objectives are:

1. To bring together specialists from the various disciplines involved in the field of instructional technology, in order to formulate requirements and establish guidelines for research and development.

2. To promote interchange of information on instructional technology as, for example, through the organization of symposia.

3. To promote and coordinate relevant research, development and application with the aim of establishing a strong, Canadian-based capability.

4. To encourage standardization of technology for instructional systems sufficient to foster the widest interchange and application of instructional material.

Throughout its activities, the Committee has benefited from the cooperation of interested and highly qualified people who are not members, through the extensive use of subcommittees and working groups for detailed duty of specific problems. In 1982, the Committee formed a subcommittee to investigate and report on the requirements of Canadian industry for applications of Computer-Assisted Learning. Subsequently, a second subcommittee was formed to address the development of a Canadian Courseware Industry. As the work of these two subcommittees progressed, it became apparent that there was considerable overlap in their assigned tasks and the studies have been merged in this combined report. Included as appendices are the individual subcommittee reports. Appendix 1, which is

the final report of a study by Online People Inc. commissioned by the Industrial Applications Subcommittee, provides a model on which a National Policy for a Computer-Assisted Learning industry might be based. Appendix 2, the report of the Courseware Industry Subcommittee, provides background information supporting the need for such an industry. A third appendix has been added that provides a sampling of views, policies and activities of public and private organizations involved in various aspects of Computer-Assisted Learning.

The report identifies an economic, social and cultural opportunity. Computer-Assisted Learning is a new industry with a significant employment generation potential; it has a major role to play in enabling the fuller participation of the individual in a society of an increasingly technical nature; and it provides a means of enhancing cultural development and understanding. Computer-Assisted Learning might well represent Canada's best opportunity to find a niche in the high-technology market place, creating jobs and providing a flexible training and retraining capability necessary to long-term sound economic growth. The need for early cooperative action on the part of industry, labour, academia, and provincial and federal governments is urgent if we are to benefit from this opportunity.

OBJECTIVE

To alert governments to: Canada's needs for and opportunities to develop a Computer-Assisted Learning industry; the strategies that might be adopted to strengthen the current capabilities in Computer-Assisted Learning development and marketing; the economic, social and cultural dangers involved in neglecting this sector; and the urgent need for action.

Decision:

Governments are asked to:

a. Recognize the Computer-Assisted Learning (CAL) industry as one of the industries critical to Canada's economic growth during the next decade.

b. Agree to the establishment of a national policy for the CAL industry, identifying goals, objectives and priorities which affect the economic independence and cultural identity of Canada.

c. Reaffirm the need for Canadian CAL materials designed and produced in Canada reflecting our unique cultural and social milieu.

d. Assign responsiblity for implementation of this policy so as to make full use of existing Canadian capabilities in federal, provincial, academic and industrial sectors.

e. Provide adequate resources to carry out this task.

BACKGROUND

Introduction -

The background and Factors sections assert that computers and information technology have already had some beneficial impact on Canadian education and training and have the potential to provide greater benefits. Moreover, Computer-Assisted Learning is part of information technology, a new economic sector in which balance of payments is a matter of great concern. Some indication is given of the current volume of activity, of the major parties involved, of the Canadian strengths and weaknesses, and of the timetable on which new developments have been occurring.

This report is accompanied by 3 appendices which provide supporting materials. Appendix 1, entitled "Canada's High Tech Opportunity," outlines a strategy for capturing a significant portion of the Computer-Assisted Learning industry. Appendix 2, entitled "The Development of a Courseware Industry in Canada," provides background material on the potential market for the courseware industry in Canada. Appendix 3 consists of submissions and status reports from industry and education.

Definition -

Computer-Assisted Learning should be understood to include the use in education and training (in the broadest sense) of large time-shared computers, microcomputers, computer-controlled image retrieval and interactive video systems, sophisticated graphics capabilities (as in computer-aided design), advanced alphanumeric and image data bases, artificial intelligence technology and new computer communications capabilities.

Industrial Training Benefits -

Computer-assisted learning has been demonstrated to be effective in responding to training needs of industry, providing benefits such as:

- flexibility: courses can be offered to individual employees at the most cost-effective time and place;

- efficiency and effectiveness: time savings of at least 30% and generally higher success rates in comparison to conventional methods have been frequently reported;

- quality control: computer-assisted learning permits standardized testing and recording of student performance even when the population is widely distributed.

Educational Benefits -

There is general agreement that this technology can add to educational capacity in many ways, for example, by means of:

- distance education: extends regular educational services to locations that are remote and under-populated;

- complex process simulation: computer simulation of processes that are too costly, dangerous or time-consuming to be included in normal student laboratories;

- education of the handicapped: sophisticated mechanisms continue to be developed to permit handicapped persons to participate in education.

Computer-assisted learning has been a subject of experimental investigation since the 1960's and its benefits have been demonstrated and recognized. However, until the recent advances in microelectronics and low-cost microcomputers, the high cost of computer technology has inhibited widespread practical applications.

Canadian Competence -

The focus of early computer-assisted learning activity in Canada, as in other countries, was on research and development in projects at universities, colleges and schools throughout the country. In the federal area,

the National Research Council of Canada (NRC) has had a research and development program underway since 1967. It emphasizes language and system standards and stresses collaboration with other centres of CAL activity in Canada. An important contribution of this collaborative program has been the development and implementation, on several main-frame computers and microcomputers, of a national CAL authoring language, known as NATAL, sponsored by NRC through this Associate Committee. The widespread use of this portable, bilingual language, domestically and in exported programs, will ensure the wide exchange of CAL courses necessary for the production, distribution and updating of these materials at the lowest possible cost. In 1980, an increasing emphasis on commercial activity began. This has resulted in the creation of a number of small, independent Canadian companies with capabilities in Computer-Assisted learning (e.g. Compris, Kanata High Technology Training Association, Metavision, Softwords), as well as capabilities in Canadian subsidiaries of the large computer manufacturers (IBM, Control Data, Honeywell).

Canadian Applications -

The benefits of CAL have been noted in many settings. For many years, Air Canada has made use of an Audio-Visual Computer-Assisted Trainer (AVCAT) in flight crew training. Department of National Defence is making extensive use of microcomputers, multi-media terminals and NATAL in its training programs, and the Correctional Services of Canada is increasing its use of computers to teach a wide variety of subjects. Within the private sector, BC Telephone Company is using the TICCIT system for training of communication maintenance technicians, and General Motors has been using the PLATO system in its program for upgrading electrical and hydraulics workers skills. So too, the Bank of Montreal has been using CAL for training tellers since 1975. During the past two years, microcomputers have started to enter the schools in large numbers, and CAL applications are being introduced at both primary and secondary levels.

Requirement For A National Policy -

Applications of CAL are seen in industry and more recently in schools at a growing rate in response to identified needs. The market will soon be a significant one. However, the market is fragmented and through lack of coordination may be supplied more readily from foreign sources than from the domestic suppliers. The Canadian industry is small but the basic competence exists to build a healthy resource provided it is given the chance to grow.

FACTORS

Industrial Training -

While it is difficult to obtain exact figures, industrial training costs in Canada are estimated to be in the range of $3 to 15 billion annually, with most of this cost attributed to loss of workers' time during training. Time savings possible through the use of CAL suggest that the

industrial training market for this technology should amount to at least $400 million annually.

Highly Trained Manpower Benefits -

It is well-established that Canada's workforce must become much more adept at developing and using new microelectronics-based technology if Canada is to be economically competitive in the coming decades. "To take full advantage of the opportunities offered by technological change, Canada will increasingly need well-educated and well- trained workers. Moreover, workers will have to acquire new skills and knowledge throughout their working lives"[1]. Computer-assisted learning is an enabling technology that responds to this requirement.

Employment and Commercial Development Benefits -

In the last two years, it is estimated that $60 million have been spent by Canadian schools on software, new microcomputer devices and services. By 1987, annual spending by Canadian schools on this technology is expected to reach $200 million (2). If this domestic market could be captured by Canadian firms, it could mean at least two thousand jobs for Canadians by 1987, increasing at an annual rate of 35% into the early 1990's. Although the industrial training and home-use markets are more difficult to define, they would result in significant additional levels of employment and commercialization.

Health Care Benefits -

The costs of the health care system could be reduced by an effective educational programme. CAL could be a useful means for distributing educational materials on preventive health care on a national basis.

Balance of Trade Benefits -

Canada has an estimated information technology trade deficit of $3 to 5 billion in 1984; the deficit is growing. Educational technology is part of this deficit. If educational technology for Canadian needs can be developed in Canada, it would eliminate a significant percentage of that deficit. It could also form the basis for the development of educational technology for export and a further reduction of the deficit (Appendix 1, Section 2, p. 43).

Market Research -

While the requirement can be demonstrated for CAL in industrial, government and academic training, the full extent of the possible applications of this technology is far from being well defined. Thus market research, emphasizing the identification of a market focus for quick success of the Canadian CAL industry, is of particular importance in the establishment of an effective Canadian resource.

[1] Ministry of State Science and Technology Canada. Towards 1990: Technology Development for Canada. DSS Cat. No. ST 31-14/1983.

[2] Extrapolated from Evans Research Report.

Retraining and Efficiency in Government and Industry -

As the economy absorbs the new information technology, there will be need for retraining of workers displaced from jobs and for training of workers to fill new positions. As the largest employer in Canada, the federal government has major requirements for retraining if improved efficiencies of operation possible through application of new technologies and procedures are to be realized. CAL will be an important component of the required training facilities. A coordinated approach to the application of CAL within federal government departments and agencies will be a vital factor in the successful development of a Canadian CAL capability that will respond to needs of both government and industry.

Skill Supply and Loss -

There are currently limited facilities for the development of CAL designers in Canada, yet demand is increasing. The skills building process must be timed to coincide with the growing needs so that there is no major deficit of skilled personnel nor drain to other countries.

Canadian Identity -

Like other, more traditional educational materials, computer-assisted learning and related materials will not enhance Canadian social and cultural development and will not produce appropriate responses to Canadian problems unless they have been produced specifically for this country. In particular, Canadian data bases must be available to Canadian classrooms so that people doing their own computer-aided research can do so on the basis of Canadian data; and computer courseware must reflect Canadian conditions, history and personalities in order to enhance the Canadian identity of learners. However, already many school boards are using software produced by the Minnesota Educational Computing Consortium (MECC). Another example of imported courseware is found in the October 1983 edition of the report compiled by the Alberta Education Computer technology clearinghouse project. Of 23 programs listed, 18 were identified as available only from U.S. sources.

ALTERNATIVES

Computer-assisted learning is affected by policies of both federal and provincial governments. Thus a national policy in this area must consider both jurisdictions. In the following alternatives, consideration has been given to those actions that could be undertaken unilaterally by the federal government as well as those that would require action by provincial governments alone or in collaboration with federal authorities.

Alternative 1: Take no action

The current situation can be described as antagonistic to the growth of the CAL industry in Canada. Some policies of governments are actively inhibiting CAL industry development and the lack of coordination is reducing the size of markets for Canadian CAL products.

Within the area of federal jurisdiction, there is no coordinated policy for CAL purchasing for federal government training; regulations delay the introduction of new learning technologies (e.g., the distribution of computer programs by cable is subject to CRTC[1] regulations); income tax regulations exclude research on effectiveness of CAL on industrial training from the definition of scientific research, considering it to be research in the social sciences and humanities; and current copyright legislation offers little protection for developers of computer software. Within the area of provincial jurisdiction, there is a lack of inter-provincial training and certification standards; and diverse activities are undertaken within individual provinces by local school boards. However, some inter-provincial cooperation is underway in information generation agencies (Radio-Quebec, TV Ontario, Alberta Access, Knowledge Network); and there are studies underway promoted by the Council of Ministers of Education that may lead to greater agreement on content evaluation and sharing of information on availability of software.

The predicted outcome if no action is taken by governments will be: a fragmentation of the Canadian market, which will be supplied primarily from the U.S.; limited opportunities for Canadian suppliers except in response to larger foreign markets; the probable loss of much of the potential of the Canadian investment in this field to date; and the deterioration of the Canadian industrial autonomy due to a reduced ability to compete in new areas.

Alternative 2: Give passive recognition of the CAL industry

This alternative would see the removal of obstructions but little would be provided in the way of positive support. Action would be primarily within areas of federal jurisdiction and would consist of a revision of legislation, regulations or program criteria that have a negative impact on CAL development and use. This would include, for example: copyright; the tax structure and access to R and D credits; CRTC regulations and the inconsistencies that exist between information carried by cable and carried by telephone networks. This alternative would result in a market for CAL that was slightly improved, but there would be no positive impact on the Canadian CAL industry.

Alternative 3: Provide positive assistance to CAL suppliers and consumers

This alternative would consist of the actions of alternative-2 plus supportive action based on a "grants and contributions" model. Within

[1] Canadian Radio-Television Telecommunications Commission

federal jurisdiction, actions would include:

- establishment of buy-Canadian incentives for training materials used in federal departments and agencies;
- development and use within federal organizations of courseware standards;
- provision of incentives to the courseware industry through tax benefits, employment grants, university-industry interface assistance, and industrial loans;
- provision of incentives to users in the form of subsidies to cover the transition costs of moving to CAL.

Within the areas involving provincial jurisdiction, actions would include:

- joint studies of problems and opportunities and cooperative action to stimulate industry;
- development of those CAL standards that would encourage a strong domestic market;
- CEIC[1] funding of training programs using CAL;
- CEIC designation of CAL development as a "national occupation" for purposes of federal support to skills training of individuals.

This alternative would result in some coordination of the market for CAL materials and encouragement of the Canadian supply side, but there would continue to be considerable fragmentation in the Canadian market.

Alternative 4: Provide directive expansion of the CAL industry

This alternative would include actions described in the preceding two alternatives plus actions based on a "contract" model aimed at promoting the appropriate implementation of CAL systems by users and at the coordinated development of the industrial supply capability.

Within federal jurisdiction, actions would include:

- the development of materials for federal training use through contracts to industry;
- commitment of the federal government to the use of CAL for its training needs in departments and agencies;
- establishment of a program to provide funds to support basic and applied research aimed at improving the development of computer-assisted learning methods and materials;
- the undertaking of international joint developments;
- establishment of a national courseware registry and clearinghouse including industrial, consumer and educational CAL, in coordination with other existing or planned registries (Appendix 1, Section 2, p. 51);
- establishment of a program to support national and international marketing of CAL by Canadian industry including support for market

[1]Canada Employment and Immigration Commission

research to identify the size and nature of national and international markets;
- identification of a centre of responsibility or focal point for CAL within the federal government;
- development of a Canadian content policy.

Within areas involving provincial jurisdiction, actions would include:

- establishment of buy-Canadian incentives for CAL materials;
- promotion and support of centres of expertise in CAL research and development;
- CEIC development of computer-assisted training materials.

This alternative would result in a large coordinated market for the Canadian supplier of CAL; a Canadian capability to respond to the needs of Canadian industry for developing new worker skills; a positive contribution to the balance of payments; a base for entry into international markets; a means of keeping trained and talented people in Canada; and an ability to address cultural requirements.

Alternative 5: Protection of the Canadian CAL industry

This alternative would consist of the actions of alternatives 2 through 4 plus actions directed at protecting the Canadian CAL industry from foreign competition.

Within federal jurisdiction, actions would include:

- application of tariff barriers to foreign produced computer-assisted learning systems and content;
- mandatory buy-Canadian policies for courseware used for federal training requirements;
- subsidy of courseware development.

Within areas involving provincial jurisdiction, actions would include:

- supply of all courseware for use in schools through a government agency;
- mandatory Canadian content quotas for courseware.

This alternative is controversial. Some argue that such measures are necessary for the protection of the domestic CAL industry. Some argue that this would result in an over-protected industry with resulting inefficiencies, isolation from developments elsewhere, and loss of access to foreign markets as other countries took equivalent measures.

***ACIT Position** - The Associate Committee on Instructional Technology takes the position that Alternative 1 does not address the problems outlined in this paper. Alternatives 2 and 3 address the problems but do not go far enough. Action at the level of Alternative 4 is necessary and sufficient action to respond to the opportunity to develop a CAL industry in Canada.*

CONSIDERATIONS

Financial -

The next phase of the CAL industry project will involve detailed market research and work plans with costing of each recommended action, to be followed up by memoranda to Cabinet, Treasury Board submissions or other instruments to implement the plans. Costs are difficult to estimate at this stage. However, it is clear that the types of costs may include:

- operational expenses, e.g. to staff and operate a data base providing information on Canadian CAL resources;
- tax expenditures, e.g. to permit tax write-off of costs of developing training courseware on the same basis as other R and D expenditures in industry;
- contributions, e.g. via CEIC, to industry and to training institutions, to pay for training programs related to CAL development expertise in Canada.

Some actions will not involve any new expenditures (e.g. revising definitions in order to make CAL materials eligible for support that is now restricted to print materials).

It should also be noted that funding levels in some cases will determine the real impact of an action. For example, a policy of developing CAL materials for use in federal training operations will require a certain threshold of funding. At or above that level, the policy would truly be a part of a "directive expansion" of the CAL industry. Below that level, the real effect would only be "positive assistance", i.e. an important but unreliable new market for some CAL material developers.

Federal-Provincial Relations -

CAL is definitely a topic with great common concern and impact for federal and provincial governments. New technology development is not only a major plank of federal industrial policies, but also the focus of many provincial industrial and educational initiatives.

These include:

- educational computer hardware and software development specifications and assistance;
- centres for evaluation and distribution of software and investigation of a national system in this regard (Council of Ministers of Education, Canada);
- special funds for high technology centres and other industry-related initiatives;
- government-led international marketing of educational materials and services.

The CAL industry initiative discussed in this document will depend on the compatibility and mutual support of policies and programs at the two

levels of government. For example, in order to create a Canadian market sufficient critical mass to allow the development of a profitable CAL industry, the internal training of the federal government and the institutional and industrial training that it supports should align with efforts of provincial institutions and programs. This would include such matters as descriptive and evaluative standards which would lead to a national courseware registry and clearinghouse service. Also required are: international joint ventures, national and international marketing assistance, and designation of the various skills required for CAL development as "national occupations" by CEIC.

The NRC CAL project has a good track record of dealings with provinces. Over the 15 years of CAL development, NRC has consulted and collaborated with many Canadian educators, and has advised school boards and education ministries. Senior education officials of various provinces regularly attend working meetings with NRC officials and those of other departments to explore policy as well as technical issues in connection with new technologies in education. In addition to NRC activities, two noteworthy examples come from DOC's work with a number of provinces on applying TELIDON to various educational uses, and on using satellites for distance education.

The next phase of the project proposed in this document would involve detailed discussions with provinces and the industrial sector. It is suggested that these be undertaken by NRC, or coordinated by NRC but undertaken by other federal bodies in the cases where those other bodies have prime responsibility for the issue at hand (e.g. Justice, DOC and CCA would deal with copyright law in relation to CAL materials).

International Trade -

As noted previously, Canada is in an increasingly negative position in balance of technological trade. A secondary goal of serving Canadian CAL needs from within Canada is to partially redress the negative trade balance. Moreover, a thriving Canadian CAL industry might find significant overseas markets. Accordingly, coordination and stimulation of national and international marketing are proposed as part of the strategy of this paper. NRC's effort in this regard would take into account the technology trade program already instituted by External Affairs, the programs of DOC and DRIE, etc.

Programs in Other Countries -

Although Canada has some programs to stimulate the microelectronic industry, there is no overall coordinated industrial policy on this issue. Several other industrialized nations have recently established R&D programs in which government and industry collaborate to stimulate electronic technology including the European Economic Community's Esprit, Britain's Alvey Directorate, Japan's Fifth Generation Computer Program, France's industrial stimulation program and the U.S. Microelectronic and Computer Technology Corporation. In some of these, CAL is a substantial part of the program. Canada could fall behind the other nations in the next few years, resulting in greater pressure to buy products abroad, further increasing our negative

position in balance of technological trade. It would be considerably less expensive to stimulate the CAL industry now in its early stage than to recapture it once foreign domination is entrenched.

Legal and Regulatory -

A number of legal and regulatory issues must be addressed in order to clarify the context in which a Canadian CAL industry would be expected to grow. The departments and agencies most heavily involved with these issues would take the lead in addressing them. Coordination by NRC would ensure that the needed legal and regulatory changes synchronize with the development of new programs and services.

Copyright -

Better copyright protection for CAL producers should provide improved incentives for creativity in CAL. At present, there is little guarantee that creators will be rewarded for their work since copying and plagiarism are quite simple, with little penalty for infringement of the present law. The revisions to the copyright law, proposed in May, 1984 by the Minister of Consumer and Corporate Affairs and the Minister of Communications, would assist in supporting the CAL producers. Especially important is the proposal to encourage copyright societies which can represent the interests of creators and collectively exploit and enforce the copyright laws in relation to their product. At present there is no such society for CAL, but there are enough producers that one could arise quickly.

Employment Opportunities:

Women - Technological change in the office and factory environment threatens women somewhat more than men. Access to retraining may be particularly important for them to cope with changes in the workplace resulting from technology.

Employment-disadvantaged minorities - Certain minorities have traditionally had fewer education, training and employment opportunities. Technological change places further pressure on these groups and increases the need for skills training and retraining.

Youth - Rapidly changing skill requirements, high youth unemployment levels, and the need for skills relating to high technology particularly affect youth. Youth may not only learn using computer technology but must also learn about using technology in the workplace.

All of the groups listed above may benefit directly from the application of CAL materials and approaches. Accordingly, with appropriate applications (which are beyond the scope of this paper), the present initiative should improve the employment situation of women, minorities and the young.

Interdepartmental Consultations -

NRC has been joined from time to time in discussion of these topics by the Science Council, ITC/DRIE, CEIC, Secretary of State, and DOC. The

next phase of the strategy envisioned here will include detailed consultations with a large number of federal departments and agencies. This will lead to new program plans (preceded in some cases by Cabinet papers) in a number of departments and agencies, such as:

- NRC (CAL technology and database development, national registry, advisory service);
- CEIC (CAL materials for training funded by CEIC, CAL as a "national occupation");
- DOC (TELIDON and communications technologies applied to education);
- EA, DRIE (industry support, marketing support).

Industrial Consultation -

There are several small companies producing CAL systems and content in Canada. Some large companies are producing courseware for internal application and for the industrial market. There are also Canadian divisions of the multi-national computer companies producing CAL products in Canada. It will be important to consult with these companies regarding the potential effects of specific policies in order to assure that these policies facilitate rather than impede the growth of their Canadian CAL activities.

CONCLUSIONS

Consultations with other departments, provincial agencies, industry and educators to this date confirm that:

- CAL is now a very small, endangered industry in Canada;

- the Canadian market could be organized in such a fashion as to support a strong CAL industry, with international market possibilities as well;

- the industrial training sector is of particular importance;

- there is a positive federal-provincial climate in terms of possible applications in the education system;

- NATAL is a bilingual authoring language capable of serving as a national standard;

- the federal government has means at its disposal to influence the appropriate development of the CAL industry, in cooperation with the provinces and the industrial sector;

- that NRC has the internal technical expertise and the acceptance by industry, by the provinces and by other federal bodies to take the lead in this area.

The CAL industry, in fact, might well represent Canada's best opportunity to find a niche in the high technology international marketplace. Failing immediate action, this opportunity will be lost.

RECOMMENDATIONS

1. That the National Research Council take the initiative, beginning immediately, to seek coordinated government planning towards a policy for Computer-Assisted Learning based on Alternative 4.

2. That approval in principle be sought for up to $4 Million to develop a strategic CAL program and implement key activities (Appendix 1, Recommendation 4.1 and 4.2; see also section 4, pp. 104-108).

3. That this program be well underway within 3 years in order to avoid foreign domination of both the production industry and the consumer market for Computer Assisted Learning in Canada.

Appendix 1

A STRATEGY FOR THE CAL INDUSTRY
CANADA'S HIGH TECH OPPORTUNITY

Report Commissioned by the
Subcommittee on Industrial Applications of Computer-Assisted Learning

A STRATEGY FOR THE CAL INDUSTRY

CANADA'S HIGH TECH OPPORTUNITY

A Report Concerning a Canadian Strategy for
Capturing a Significant Portion of
the Computer Assisted Learning (CAL) Industry

Prepared by:

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April 30, 1984

A STRATEGY FOR THE CAL INDUSTRY
CANADA'S HIGH TECH OPPORTUNITY

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SECTION 1 - REPORT OVERVIEW AND SUMMARY

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CHAPTER 1

PURPOSE OF THIS REPORT

This report was commissioned by the National Research Council, for its Associate Committee on Instructional Technology. Its purpose is to make recommendations concerning a Canadian strategy for a CAL Industry.

The report was originally requested to focus on a strategy for CAL in industrial training. It was found, however, that, in considering a strategy it is not feasible to segregate the Industrial Training Sector from the Educational and Consumer Sectors. Therefore, the focus of the report changed to one of an overall CAL industry strategy (Sections 1 to 5), with an additional section that applies the proposed strategy specifically to the Industrial Training Sector.

A - THE SCOPE OF THE REPORT

The scope of the report is limited. It identifies what is considered to be a highly viable strategy for exploiting a major Canadian opportunity. It identifies many technical, economic, political, and sociological issues that must be resolved in order to implement the strategy. Through 34 specific recommendations it blueprints an approach to:

- addressing feasibility and other issues
- developing a detailed business case
- developing a multi-stage plan for implementation

It does not provide detailed feasibility analysis -- it describes how to accomplish that analysis as a first stage in the multi-stage plan.

It does not provide a business case -- it addresses how a business case should be developed, and shows that there is a large opportunity that warrants the launching of a first stage within which a business case is to be developed.

This report attempts not to go over old ground. A bibliography lists many of the documents referred by this study but no attempt at summarizing their findings has been made, even though many of the concepts presented here were stimulated by this material.

Special acknowledgement to Teresa Plowright for Computer Learning: The Policy Imbroglio.

B - THE CONTENTS OF THE REPORT -- WHAT TO READ

This section, Section 1, provides an overview of the findings and recommendations of the report. It should be read first.

Section 2 describes the strategy and its primary rationale. It should be read by anyone desiring more than a cursory understanding of the recommendations.

Sections 3 and 4 address technical and other issues raised by the strategy, and discusses their impact, and how they should be addressed. They should be read only by people who wish to delve into the full implications of the overall strategy.

Section 5 is a structured articulation of the 34 recommendations of the report, annotated with rationale and a careful mapping of the recommendations to the earlier sections of the report. This section should be read carefully by anyone interested in understanding the steps required to investigate and implement the strategy described in Section 2.

Section 6 addresses the Industrial Training Sector within the context of the overall strategy. It should be read by people specifically interested in this sector, but it cannot be used as a stand-alone analysis.

Section 3, 4, and 6 each have a chapter of "Detail Notes", which are additional materials relevant to the content of the sections but not necessary to their understanding.

CHAPTER 2

MAJOR FINDINGS

The essential message of this report is that despite the apparently minor role that Computer Assisted Learning (CAL) plays in Canada's economy today, it represents our major opportunity for a significant niche in the Information Technology Industry.

There is a relatively narrow window in time within which this opportunity must be seized. After that, it is hard to understand how Canada can avoid becoming a "have-not" nation in the world of International Information Technology which confronts us in the late 80s and 90s.

It proposes a bold goal for the CAL industry in Canada, with very ambitious targets concerning:

- Direct employment generated by the Industry
- Direct contribution to Canadian balance of trade
- Major contribution to superior education in Canada
- Major contribution to productivity and effectiveness in all Canadian industries, with resultant impact on GNP and trade balance.

It proposes an approach to meeting these goals which, as a major side benefit can play a key role in launching Canada into potential future Information Technology areas such as knowledge bases.

CHAPTER 3

MAJOR RECOMMENDATIONS

The recommendations of the report, which are fully described in Section 5, are as follows:

INDUSTRY PLANNING APPROACH

The basic recommendations are that plans for the CAL Industry:

- utilize the report's three program solution strategy (the Canadian Courseware Registry, the co-ordinated CAL Industry support program, and the courseware development productivity program) as the basis for further planning and development
- address technological, economic, and political issues
- identify practical steps to achieve a useful level of consensus on policy and further plans
- not only continue but enhance support of industry activities outside the report's three program strategy
- include the formation of a broad national group composed of all sectors of the industry to continuously review and re-orient industry goals, strategy and plans.

INDUSTRY SUPPORT APPROACHES

In funding CAL Industry Programs, it is recommended that support be organized into three streams and that each of the streams run concurrently.

1) Strategic Development

This stream is for direct investment in specific projects which due to their nature are for the common good but not attractive as private sector projects. They are best launched and funded centrally. This includes:

-projects, such as strategic CAL Industry planning, conducted and staffed by a government body

-projects, such as technical feasibility studies, contracted by a government body to a private organization

-projects, such as developing some types of industry standards, performed by a private sector organization with funding by government.

2) Strategic Encouragement

This stream of support is composed of direct funding and other forms of central support (such as tax incentives) for projects that serve the common good. However, the projects are also attractive as private sector activities that could become a viable part of an enterprise.

This would include;

-development of authoring languages
-creation of courseware development methodologies
-design of a CAL curriculum

3) Ad Hoc Support

This stream of support is for funding quality CAL Industry activity that does not happen to be in unison with strategic CAL Industry planning. This would include, for example, funding of the research and development of new courseware presentation equipment even though support of the equipment component of the Information Technology Industry is not strategically recommended.

FIRST STEP RECOMMENDATIONS

For the first thrust that is taken in support of the CAL Industry from the proposed strategic plan, it is recommended that the thrust include;

1) The naming of a CAL Industry Strategic Planning Agency with a mandate to produce a National CAL Strategy that includes;

   - a description of roles for CAL industry participants, and
   - an industry plan composed of 10 year, 3 year and 1 year components.

2) The launching and funding of Strategic Development projects such as;

   - a full technical and business feasibility analysis of the recommended strategy

- a preliminary design of the Canadian Courseware Registry Standards and support systems

- a preliminary design of courseware creation productivity tools including new generation authoring tools and courseware development methodologies.

In summary, there are some recommendations whose feasibility must be tested further before they are acted upon. There are many recommendations that can be immediately effected for a modest investment that will determine what can be accomplished. With this relatively small investment, the first steps are risk-free because they will provide in any event invaluable insights on how to exploit the Information Technology Industry.

The recommended start-up program for the strategy requires a relatively modest investment that will further determine which of the recommendations should be undertaken, and in what sequence.

SECTION 2 - A CANADIAN CAL INDUSTRY STRATEGY

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INTRODUCTION

This section of the report is the description of a strategy for Canada to utilize in securing its position in the world CAL Industry. The section contains no references to other materials supporting the rationale of the proposed strategy, nor any quantification of market costs, revenues or benefits. These elements are part of other sections of the report.

The purpose of the section is to provide an overview of the opportunity, the issues affecting it, and a strategy for seizing the opportunity. The strategy is spelt out in more depth in Section 5, through a series of detailed recommendations.

The strategic model presented here is not itself dependent on the issue of what private or public sector organizations will implement the programs described.

In any event, cooperation between Federal and Provincial governments will almost certainly be required because these programs fall within both areas of jurisdiction; it is probable that private sector investment and initiative is also required, through consortia of involved industry companies and/or venture capital injection.

What is certain is that a successful implementation of this strategy will require cooperation, capital, and national-level planning, including the development of a viable who-does-what proposition.

CHAPTER 1

A GOAL FOR CANADA'S CAL INDUSTRY

The goal envisioned for the Canadian CAL Industry by this report is not merely that of an industry which consists of some profitable companies, each with a reasonable share of the Canadian market, and, with luck, a modest share of business outside of Canada. Rather, it is one in which Computer Assisted Learning (CAL) is:

1 - A major employer of Canadians, providing alternative means of income not only for the many members of the teaching profession who might be displaced from the traditional classroom by advanced information technology, but also for many other Canadians whose jobs are already being affected or displaced by advanced technology.

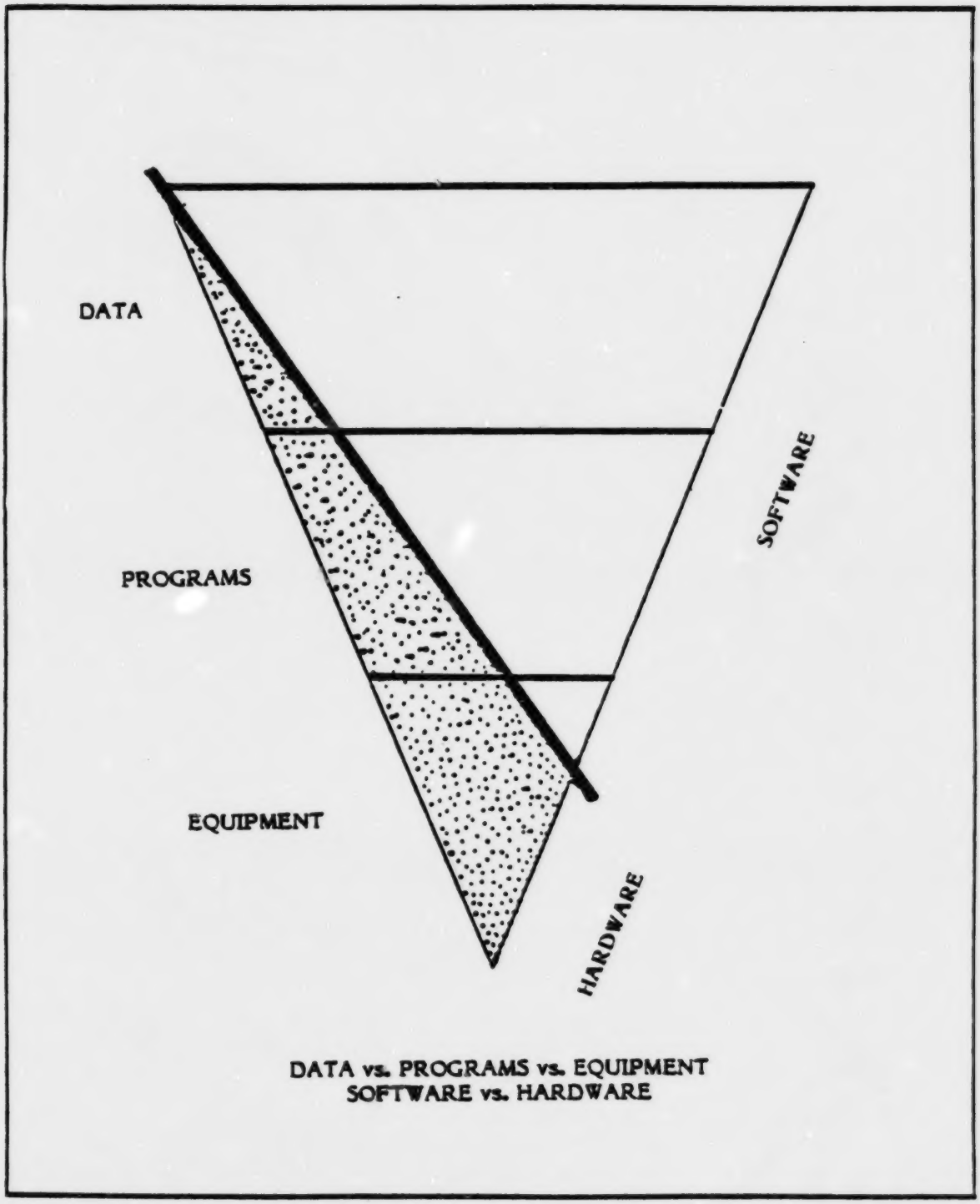
2 - A major contributor to the Canadian balance of trade, providing sufficient export volumes to compensate for the large negative trade balance expected to be generated by other components of the information technology industry, such as computer equipment and office automation. This implies a required goal by the mid-nineteen nineties of a positive flow of up to $15 billion.

3 - A major contributor to superior Canadian education, providing Canadians with a competitive intellectual edge in an international society where knowledge and skills are a key to economic well-being at the individual and national levels.

4 - A major contributor to productivity and effectiveness in all Canadian industries, through superior cost-effective training in areas where Canadian products and services must compete world-wide, and through the availability of specialized knowledge in those areas, such as natural resources, in which Canada has inherent advantages.

The position of this report is that such goals are clearly possible to meet. Achieving the goals needs only the forming of some level of Canadian concensus and the setting of a strategic plan within the next very few years. The strategy would require the mobilization of many elements of Canadian society, including Federal and Provincial governments, the education industry, private capital, and those companies within the private sector which are already participants in the CAL industry.

COMPONENTS OF AN INFORMATION TECHNOLOGY SYSTEM



DATA vs. PROGRAMS vs. EQUIPMENT
SOFTWARE vs. HARDWARE

DIAGRAM 1

CHAPTER 2

THE CAL OPPORTUNITY

Assuming that Canada has a requirement for a niche in the Information Technology Industry, an examination and analysis of the components of an automated information technology system indicates that CAL is probably the best opportunity which Canada has to fulfill the goals as described in Chapter 1.

A - MARKET OPPORTUNITY FOR INFORMATION TECHNOLOGY COMPONENTS

1 Data vs. Programs vs. Equipment

There are three major components to an electronic information system, represented by the inverted triangle of **Diagram 1**. These are equipment, programs and data. Equipment is at the bottom of the triangle because programs cannot be operated without it; data is at the top, because the execution by the equipment of programmed logic is necessary to process it, to generate it, or to support the communication of it between people and people, people and equipment, or equipment and equipment.

Traditionally, the way in which people and organizations have acquired this technology, for use in areas as diverse as accounting or training, has been to first purchase equipment, then find or develop programmed logic that can run on the equipment, and then use the combined equipment and programs to process data.

The triangle of **Diagram 2** (opposite the following page), however, is shown as inverted because the economic significance of the three elements are the reverse of the traditional acquisition sequence. Data is the user's need; equipment and programmed logic are simply the means to that end. Generally the investment in dollars and labour in all of the programs that eventually are run on a piece of equipment is several times greater than the equipment itself; and, if the equipment-program combination has been successfully used, the economic value of the data inventory will eventually and significantly exceed the value of the sum of the programs and equipment.

This inversion holds equally well for any application of computing technology, such as accounting, engineering, and, especially for CAL. Equipment is, in the long run, the least significant aspect of CAL. The programs which support the development, presentation and management of CAL courses are a more significant element; and the knowledge inherent in the courses, that is, knowledge of subject

matter and knowledge of instructional technique for communicating the subject matter, is the most significant element and the end purpose of the CAL system.

2 Software vs. Hardware

Another way to look at the model is in terms of hardware and software. If hardware is defined as something tangible (can be felt and touched), then almost all computing equipment is hardware, as well, for example, as the media on which programs and data are stored. If software is defined as intangible (nothing to feel and touch other than the media on which it is stored), then almost all programmed logic and data today can be considered to be software. The shaded area of **Diagram** 1 represents hardware, the unshaded portion software.

Although the diagram shows that not all equipment is hardware (for example, the operating system of a computer can be considered part of the equipment in that no programmed logic can be executed without it, yet it is normally delivered as software) and not all programs and data are necessarily software (programmed logic and even some data can be delivered in the form of equipment such as chips). Today, and for the foreseeable future, the largest base for business activity lies in the area of software.

3 Unsaturated vs. Saturated

Diagram 2 is almost identical in shape to **Diagram** 1, except that in this case the shaded and unshaded portions refer to the degree of market saturation or penetration. The unsaturated proportion of the total available marketplace is what's left over, after the major companies and countries already in the computer field have taken their likely share of the market. The major portion of the equipment marketplace, no matter how that marketplace will grow, will be taken by the companies established in the equipment industries, for the most part companies that thrive in countries such as the United States and Japan that have the appropriate capital intensity for the equipment field.

Therefore the shaded portion of **Diagram** 2, represents also the portion of the entire information technology industry which would require the highest capital investment to make any major impact on the market; not only the cost of manufacture, but the cost of grabbing marketplace away from companies like IBM and AT & T.

Data, on the other hand the largest of the marketplaces, is also the least penetrated to date, and the area in which Canada has the best

PENETRATION OF INFORMATION TECHNOLOGY COMPONENT MARKETS

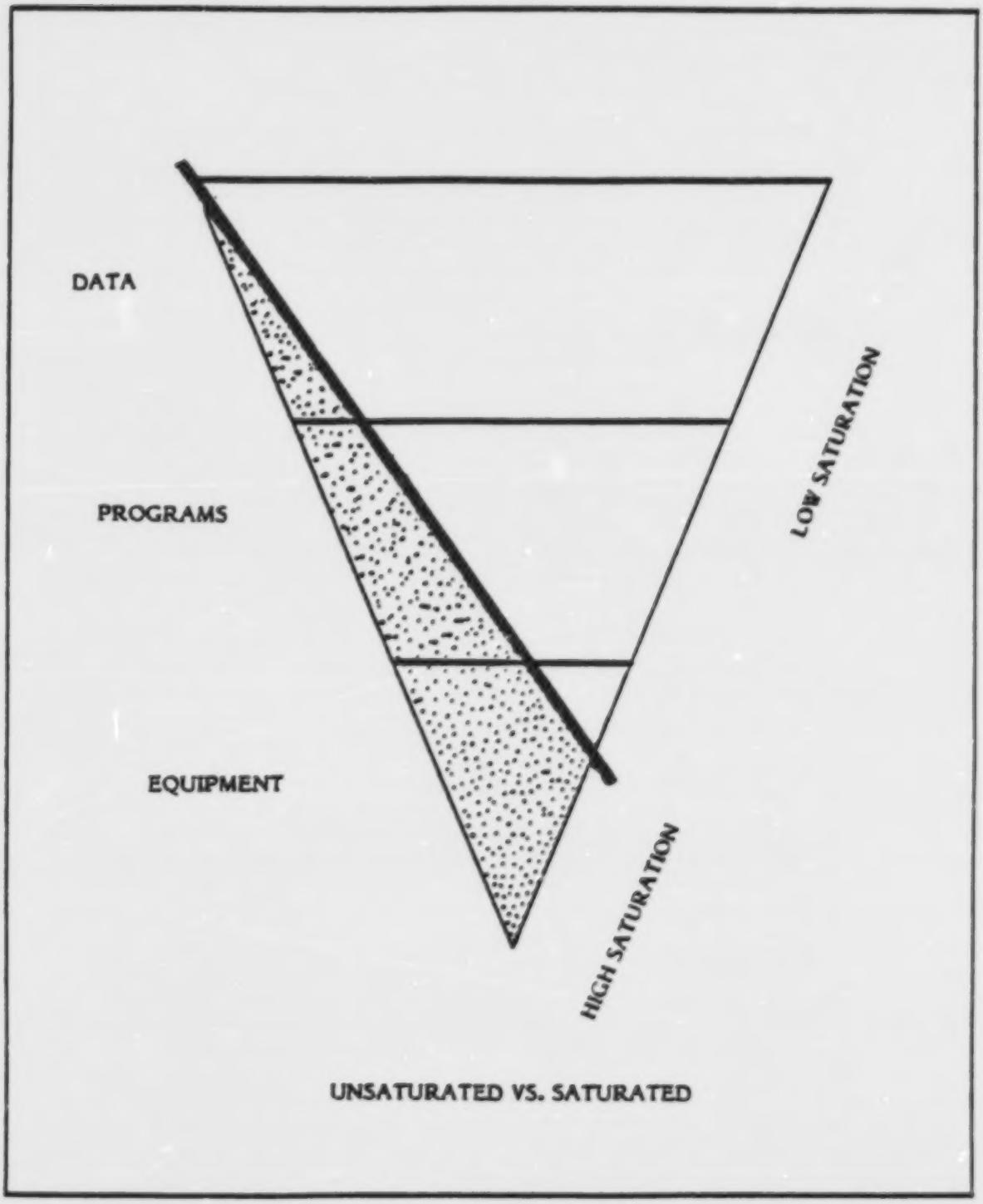


DIAGRAM 2

PENETRATION OF THE DATA MARKET

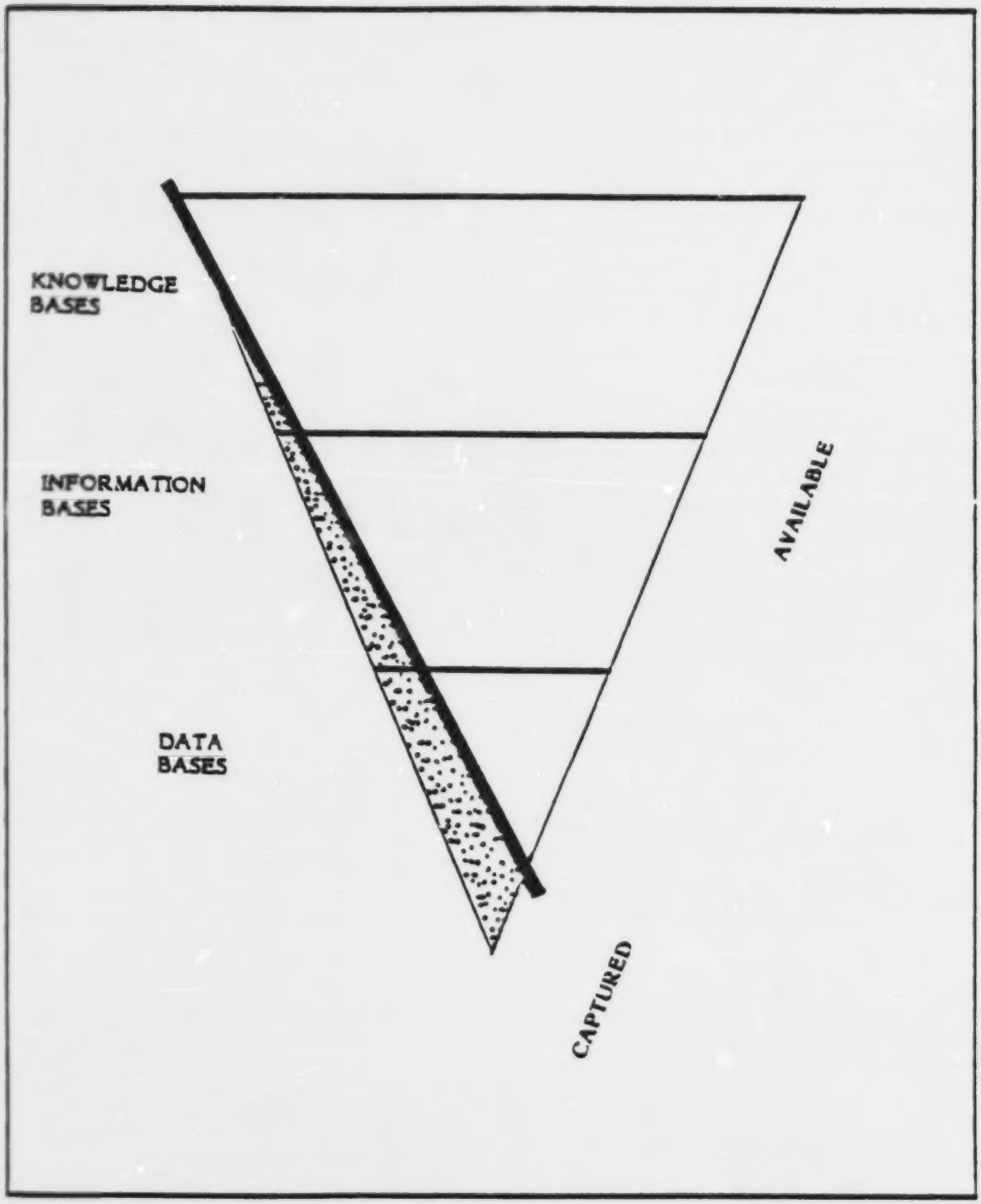


DIAGRAM 3

chance to achieve the highest leverage on the investment in dollars and energy that it can afford.

B - PRODUCTS IN THE HIGHEST OPPORTUNITY MARKET

Dataware, i.e. computer-readable data for sale, is a very recent phenomenon. Prior to the 70s, most companies used their computers to key in their own data for manipulation to their own future use. In recent years, however, improvements in communications have made the purchase of data attractive, and this trend has been enhanced by the adoption of computer media as a first step to producing printed text, and therefore the production of data on media has become a byproduct of the process.

Data for sale has already been identified as a large-potential industry, and companies in every country are hurrying to position themselves for that market. Telidon and companies such as Infomart and Infoglobe are excellent Canadian examples of the rush to cash in on this new technology. This makes sense because, as shown in **Diagram 2** it is the largest unpenetrated marketplace today, with a potential far greater than that of equipment and programmed logic combined.

Within the area of dataware lies Canada's largest opportunity, and it is therefore valuable to describe it in more detail. In fact, dataware can also be broken into three types of product, and represented in significance and penetration by **Diagram 3**, which is quite similar in shape to the other diagrams.

Data bases are files of raw data which can be used by the programs of the companies who buy them, rent them, or buy access to them, to produce information that they require. An example is a commercially available list of 10-year stock performance of companies on the New York Stock Exchange.

Information bases contain pre-digested information, that is, data which has been analysed or massaged to provide information more directly to the user, without requiring the usage of programmed logic. Information bases, then, are the result of the application of expertise to raw data. An analysis of strengths and weaknesses of companies on the New York Stock Exchange is an example of an Information Base. Information Bases tend to have more text and graphics, and less rigid structure than data bases.

Knowledge Bases are structured collections of knowledge about specific fields, or procedures for accomplishing specific results. Computer Assisted Learning can be considered one form of presentation of the contents of a knowledge base, and CAL

courses are, therefore, probably the only wide-spread current example of knowledge base technology, but this branch of dataware will become the most significant lever for the "Information Society" of the late 80s and 90s. Remarkable advances in Artificial Intelligence (AI), mass storage, and very high speed communications, such as have occurred in the last half-decade and will be accelerated during the remainder of the 80s, will make it possible to build comprehensive knowledge bases of, for example, medical disciplines, mining technologies, and mathematical theories. Once human knowledge has been captured and structured on a knowledge base, that knowledge will then be extendible by applying computerized inference logic to produce new knowledge.

CAL is a major opportunity for Canada (**Diagram 4**), because it is our entry card into the largest portion, knowledgeware, of the largest aspect, dataware, and the least penetrated market of the information technology industry. From the base we can secure in this area, through CAL, we will have a natural foundation for evolution into other aspects of knowledgeware, including the provision of knowledge bases for use in artificial intelligence, and in industrial robotry.

CANADA'S HIGH TECH OPPORTUNITY

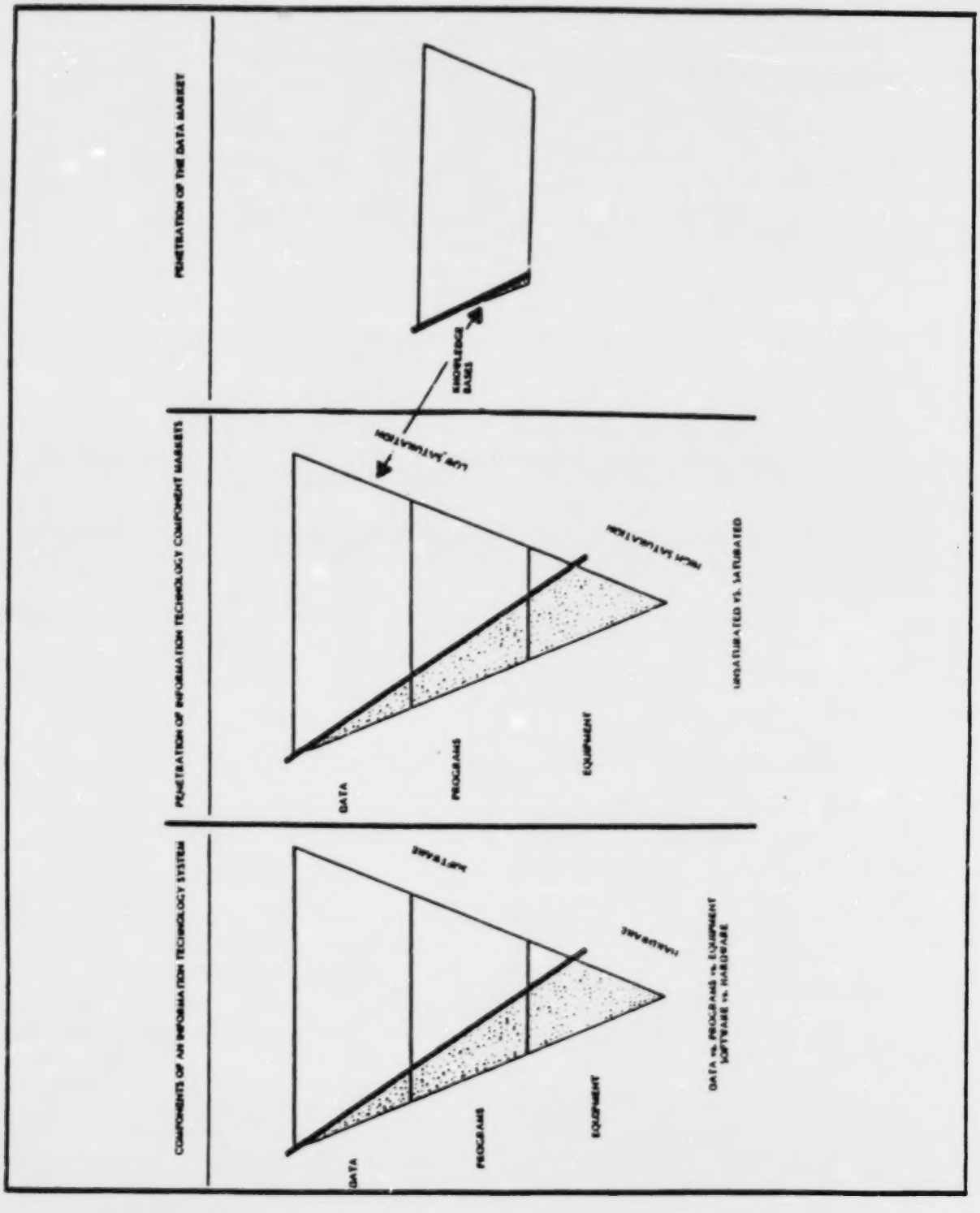


DIAGRAM 4

C - REQUIREMENTS OF CANADA'S NICHE IN THE INFORMATION TECHNOLOGY INDUSTRY

Although there is little agreement today concerning the economic and industrial profile of our world in the 1990s, there are very few experts in any field that disagree with the assertion that information technology will be the dominating factor of the 1990s and of the 21st century. This refers to information technology as a tool for all industries as well as an industry itself.

In fact, it has been said that in the 1990s the information-technology poor nation might be in the same position as the oil-poor nation of the 1970s, not only in terms of its direct impact on the economic well-being of that nation, but also in areas such as political and security dependence on other countries.

Canada is off to a poor start in information technology, with a visible trade deficit in computing and office technology alone that easily exceeded, by 1983, $3 billion annually. If one includes estimates of the more difficult to measure aspects of information technology today, this annual deficit probably exceeds $5 billion today, and, assuming no miracles, could grow to $25 billion by the mid-1990s.

Several countries who have a strong understanding of its significance have launched major initiatives towards dominance or major market-shares in the field of information technology. "Japan Inc." is a much-discussed topic with its assault on "Fifth Generation" technology, and others such as France, Britain, and the United States are also formulating major strategies and launching programs to implement their strategies.

Although it is a common and convenient practice to criticize Canada for not having already launched an effective "Canada Inc." thrust, the problem has, in fact, been under study by Canadian policymakers for some time. Canada is ill equipped, however, to compete with major industrial nations along the lines which those countries are pursuing; we suffer, comparatively speaking, from major handicaps such as our small population, our geographic dispersion, our political and social structure, the high quality-of-life standards that hamper our ability to compete in the world labour market, and our lack of major facilities and capital for competitive research, development, and manufacture. Within the prevailing concept that all technology translates into equipment, the truth is that Canada's natural profile is one of a high user of information technology and a low producer, and there is probably little that can be done about this fact through any initiatives that any government could launch.

Therefore given the current reality, Canada, to have its share of the information technology pie, must find special areas to pursue. Those special niches are those in which:

Most aspects of it are not capital-intensive nor blue-collar labour-intensive.

It does not bring Canada into head-on competition with major industrial powers because they are not currently focussing in this area.

The marketplace is still a largely future marketplace, and so there is very little penetration today by major industrial powers. On the other hand, it must already be a large enough marketplace to nourish a major start and to pay for a developing industry.

It is a field which is very suitable for a small highly-educated population, with its own high domestic requirement for the product. It must also take advantage of the mosaic cultural character of the country in so far as the development of products for other nations is concerned.

It has sufficient future potential (if properly guided and nurtured) to bring Canada to the broader knowledgeware industry, beyond CAL, that will have the major impact on the Canadian economy.

D - CONCLUSION

The CAL Industry represents Canada's greatest opportunity to have a major slice of the information technology industry of the future. It meets all the national requirements, and it addresses the largest remaining marketplace. For this reason, it fully deserves to have national priority in policy and investment. Canada has an opportunity to become "teacher to the world".

CHAPTER 3

A CANADIAN CAL INDUSTRY STRATEGY

A - NATIONAL INDUSTRY REQUIREMENTS

Based on the analysis of the previous sections, two requirements emerge concerning the way in which CAL is approached in policy-making and planning for Canada.

Courseware must be seen as a form of dataware
- maintained and manipulated as knowledge bases of subject matter and instructional techniques for communicating the subject matter
- marketed, distributed, and accounted for as dataware, not programware.

Courseware must be seen as an independent entity, separate in its design from:
- the hardware/software environment in which it is developed
- the hardware/software environment in which it is presented
- the authoring tools by which it is created.

Although the development and marketing of courseware is the primary aim of a CAL industry, within the context of this strategy proposal, the industry is not limited to these activities only. In fact, any vision of a thriving Canadian industry in CAL implies five major areas of participation that are listed below.

1 - Canadians developing CAL programs to be used for development, presentation and management of courseware.

2 - Canadians developing and manufacturing equipment to support course development and course presentation.

3 - Canadians developing, packaging, and teaching Courseware development expertise, including authoring methodologies and instructional techniques.

4 - Canadians developing Courseware

5 - Canadians storing, marketing, and distributing and supporting Canadian CAL products within and, more significantly, outside of Canada. These products include courseware, as well as programware, equipment, and packaged expertise.

Item 4, Canadians developing courseware, whether for sale or for use in the organization within which the activity takes place, is the primary priority of a CAL industry, because:

- Courseware significantly enlarges employment. Courseware represents the largest opportunity of all CAL Industry components for participation by the largest number of Canadians in the largest information technology industry that fits the Canadian situation.

- Courseware greatly enhances Canadian industrial productivity. Courseware can have the greatest effect on productivity in industry and education in general and specifically effect productivity for selected world scale Canadian industries such as forestry and mining.

- Courseware, domestically created, reduces imports. Particularly for industrial use, the demand for courseware is growing dramatically.

- Courseware domestically created, increases the opportunity for export. As well as for Canada, the world industrial demand for productivity improvement through courseware is providing very large opportunity for export.

- Courseware is an exportable product. Courseware is the most likely CAL area in which Canada can compete outside of Canada. Canadian courseware has no inherent disadvantage in the export markets, is least likely to run into direct competition, and is most easily marketed.

Once item 4 has been adopted as the major priority, then item 5, the marketing of Canadian CAL products becomes paramount in importance. It is imperative to have a mechanism for marketing Canadian products (courseware in particular) outside of Canada. Canada, as such, is seldom a large enough marketplace to provide adequate payback for equipment, programware or courseware products; large scale export is mandatory in order to achieve the volumes necessary to provide good profit incentive, and to meet the trade balance goals of the industry.

Items 1, 2 and 3, though of relatively minor economic significance on their own merit, become important in support of items 4 and 5. Although there is always a marketplace for CAL programware, particularly in the area of improved presentation and management, the most important need for Canadian programware is to support Canadian courseware. In the same way, once a good Canadian programware environment has been identified, there is probably a good opportunity for equipment to support it, particularly in the area of courseware presentation. It is courseware, ironically, which can create the marketplace for programs, equipment and packaged development expertise.

B - THE THREE PROGRAMS OF THE SOLUTION STRATEGY

On the basis of the CAL Industry future being in courseware, there appears to be three basic programs which must be put into place to ensure the success of a Canadian CAL Industry strategy. These are:

1- The Canadian Courseware Registry
A "Library of Congress" type of system is required, whereby all courses could be catagorized, catalogued, stored, and reproduced for distribution, with usage tracked. This would be a strong incentive to schools and other users of education to utilize courses in the registry because of ease of use. Usage tracked for royalty purposes would be a strong incentive to authors. The registry is necessary, then, to encourage the use of Canadian courseware throughout Canada, and to make possible a coordinated marketplace for authors. The registry also makes possible the support program described next.

2- The Coordinated CAL Industry Support Program
Through Public and Private Sector initiatives, a major marketing campaign to sell Canadian products outside of the country would be a major factor in the success of a Canadian Courseware Industry. This could operate on two market types:
- Active marketing of existing Canadian courseware within the marketplaces of other countries.
- National-level contracting (build to requirements) for major CAL needs of countries that do not have the capability of their own. In such a scenario, Canada would undertake to develop for another country to meet its educational requirement, and then course authors (project teams) would be hired to fulfill the contract.

3 - The Courseware Development Productivity Program.
In any industry in which Canada wishes to compete with other industrialized nations, it requires a productivity edge in the highest-volume segment of that industry. This has been so in all world industries even in "old" industries such as the automotive industry where, for example, the Japanese succeeded largely through superior productivity in automobile manufacturing.

This means that a key element of a successful CAL Industry is courseware development productivity - the cost effective production of a high quality product. Productivity of courseware development would be dramatically improved by three mechanisms: new and enhanced authoring tools (programware and equipment), effective courseware development methodologies, and education programs for courseware creators.

C - INDUSTRY CONSTRAINTS

Unfortunately, there are two major constraining factors which must be addressed before the three programs described could be practically implemented.

Constraint 1 - The Muddled CAL Industry

There is already a large inventory of CAL products (equipment, courseware development/presentation tools and courseware) on the marketplace today, ranging from "home-brew" systems developed by individual users of education (schools, industries), through mainframe-based systems being offered by major companies such as IBM, Honeywell, and Control Data, to micro-based systems being offered by many small companies in the open marketplace. Some products are simply implementations of others in a different equipment operating environment, but the majority utilized a wide variety of different courseware development methodologies and "languages" (many of which are not easily differentiated from standard computer programming languages) as their basis.

Most organizations which have invested in CAL products also have an inventory of courseware which they purchased to run under that product or which they themselves developed using the product. To make things more complicated, most of the early approaches to CAL software have not differentiated between the development environment and the presentation environment; a course developed on a particular product must be presented on the same product. Few of these products implement a perspective in which the courseware itself is looked upon as a data (knowledge) base.

This situation of a muddled industry is currently multiplying, as more and more companies and users are turning to CAL. By the time any Canadian strategy could be put in place, it is reasonable to assume that, however measured, the industry muddlement will have doubled as compared to today.

Constraint 2 - Limited Leverage for Authors

For a courseware industry to develop, there must be a good payback to authors for their effort. The many different equipment environments and authoring languages greatly reduce the total marketplace for any specific coursewriting effort, because the courseware element of most methodologies is not treated as dataware which can be accessed by a variety of programs, but as part of the presentation program.

This means that a course, today, is generally written for a particular equipment environment, and its marketplace, therefore, limited to those companies or individuals that own that particular hardware/software environment. To sell to another equipment marketplace requires, at its worst, a complete re-write of the course (and sometimes in another authoring language because the new equipment does not have an implementation in that environment), and, at its best, a considerable expenditure of effort and time to convert the course.

Unless the above two constraints can be addressed, there is every reason to believe that the successful implementation of the three solution programs would be blocked.

A Canadian Courseware Registry might fail because of the difficulties implicit in attempting to maintain information about courseware written in a myriad of environments, presentable in narrowly constrained environments. If the registry were limited to courses written in a "Standard Authoring Language", it would be too limited in scope to satisfy the requirements of authors or users.

A marketing program might fail because the volume of courseware available would not be adequate. The authors/producers would not be in place to generate new courseware and the existing base of courseware would be viewed as many different products none of which are individually large enough to justify an international marketing program.

The courseware development productivity program might fail because the muddled CAL Industry would not allow the identification of the developers/producers of courseware who would utilize the productivity tools and education programs - even if they had the incentive to participate in the industry.

In order for a Canadian strategy to succeed, therefore, it must be able to integrate existing software/hardware presentation environments, existing authoring languages, and existing courseware -- the strategy can not wipe out the past and start anew.

The remaining 3 chapters of this section describe each of the three solution strategy programs - the Canadian Courseware Registry, the Coordinated CAL Industry Support Program and the Courseware Development Productivity Program - and how they address the major constraints of a muddled CAL Industry and limited leverage for authors.

CHAPTER 4

THE CANADIAN COURSEWARE REGISTRY

A - REQUIRED STANDARDS

An essential ingredient of the approach to dissolving the constraints of a muddled CAL Industry and the lack of courseware author incentives is the development and publication of Canadian Courseware Registry Standards (CCRS). These standards would include:

- A Standard Courseware Description Format -- that is, a standard method of recording information such as what a course is about, who authored it, who its audience is, its depth of coverage, its essential instructional techniques, the original authoring environment of the course, and the hardware/software environment in which the course, in its original form, can be presented.

- A Standard Courseware Conversion Code -- that is, a standard way of representing on media how the courseware's essential ingredients are stored, for the purpose of universal courseware interchange, no matter what authoring technique or software/hardware environment was utilized in the original development or presentation of a course. This would include:

    - Its subject knowledge content
    - Its presentation logic
    - Its presentation media usage
    - Its course management content
    - Any other content

A second essential ingredient is the existence of a series of tools that support conversion of existing courseware from its "Source" format to the Conversion Code Format of the CCR. The tools would be hierarchical in nature, consisting of a "Source Conversion System" of tools that apply to any conversion process, and specific programs that apply to the conversion of each particular source environment for which tools have been prepared.

The third essential ingredient is the existence of a series of tools that support conversion of courses that are in the Conversion Code format of the CCR to existing equipment environments for course presentation. These tools would also be hierarchical in nature, consisting of a "Target Conversion System" of tools that apply to any conversion process, and specific programs that apply to the

conversion to each particular target presentation environment for which tools have been prepared.

In this approach, there are two important considerations:

There should not be an expectation that totally automated conversion of source or target will be available. Although this may occur for some sources or targets, particularly for systems developed after the standards have been widely accepted, the normal expectation is that the conversions will continue to be reasonably labour-intensive, with the tools dramatically improving the effectiveness and reducing the total labour required initially and especially over time.

As part of a strategy implementation program, it would probably be necessary for at least a first implementation of a "Source Conversion System" and a "Target Conversion System", and it may also be wise to develop ahead of the strategy launch some environment-specific tools for some of the highest-inventory course development and presentation environments, but it is not expected that all of the source or target-specific programs that will eventually exist should be developed up front, as part of the strategy implementation program. Instead, it is expected that independent entrepreneurs in the CAL industry ("OEMs") will gradually shift much of their attention from the development of new environments to the development of these conversion tools, and that major vendors of courseware, CAL programware, and CAL equipment will gradually become motivated to develop such tools themselves. Should the program succeed to its full potential, eventually new authoring languages, development systems, and presentation systems will be designed to generate additional courseware code that meets the registry standards, or manages courses with minimum conversion from the formats.

The advantages of incorporating these ingredients within any strategy implementation program would be as follows:

- Authors would have some level of assurance that no matter what environment was used for development, within some minor constraints, their courses would run in a majority of presentation environments, thus providing larger revenue leverage for their efforts.

- Users of education would have a strong incentive to utilize the registry because they could use many of the courses which otherwise would be unavailable for their presentation equipment configuration.

- International marketing would also be greatly enhanced, because our entire inventory of existing courses would be available for sale to a much broader range of customers, and because Canada would be clearly perceived to have a CAL delivery mechanism. In fact Canada's national-level customers could be further motivated to do business with us because the registry system itself might be a product available to them.

- The entire CAL-related programware industry, including new organizations that would arise in response to the need, would have an additional focus, besides the development of course authoring and course presentation packages, of conversion tools. The whole CAL Industry would have a powerful incentive, with firm standards to work to.

B - THE TECHNICAL ENVIRONMENT

A basic model of the industry, as it could develop around the essential ingredients of a CCR standards system and the supporting conversion systems is shown opposite in **Diagram 5.** Central to the model is a "Canadian Courseware Registry", supported by a "Canadian Courseware Registry Support System" based on the Canadian Courseware Registry Standards (CCRS). The data bank associated with the system probably consists of the following databases.

- Course descriptions, according to the Canadian Courseware Registry standard format for courseware description. Includes information as to whether the course itself is stored in the registry, and, if not, where it can be obtained. All participants in the registry would be included in this database.

- Courses, stored in the Canadian Courseware Registry Conversion Code Standard for courseware interchange. This would include all courses that have been originally generated into the CCR Standard, and those from other authoring systems codes which have been successfully converted into the CCR Standard.

- Source courseware, stored in its original format. All courses submitted to the system would be stored on this database, including those which have been successfully converted to the CCR Conversion Code Standard, for reasons of backup, and of machine efficiency when required for operation a presentation environment that is the same as the original source. At least at first, some participants in the registry might be permitted to keep their course descriptions on the system, but to insist that they themselves will keep the original source, and undertake delivery responsibility themselves, when the course is requested.

- Target courseware, stored in its own format after undergoing CCR Conversion Code-to-target conversion. Those courses which have a high usage profile in certain target environments may be maintained in this format to reduce the cost of repetitive conversion.

- Authors and Users Registry, with accounting and usage data, for purposes of billing, royalty, statistical analysis, and accounting.

The Courseware Registry Support System in the model is a software and people system whose purpose is to maintain the databases, and to manage other Registry activities.

CANADIAN COURSEWARE REGISTRY SUPPORT SYSTEM

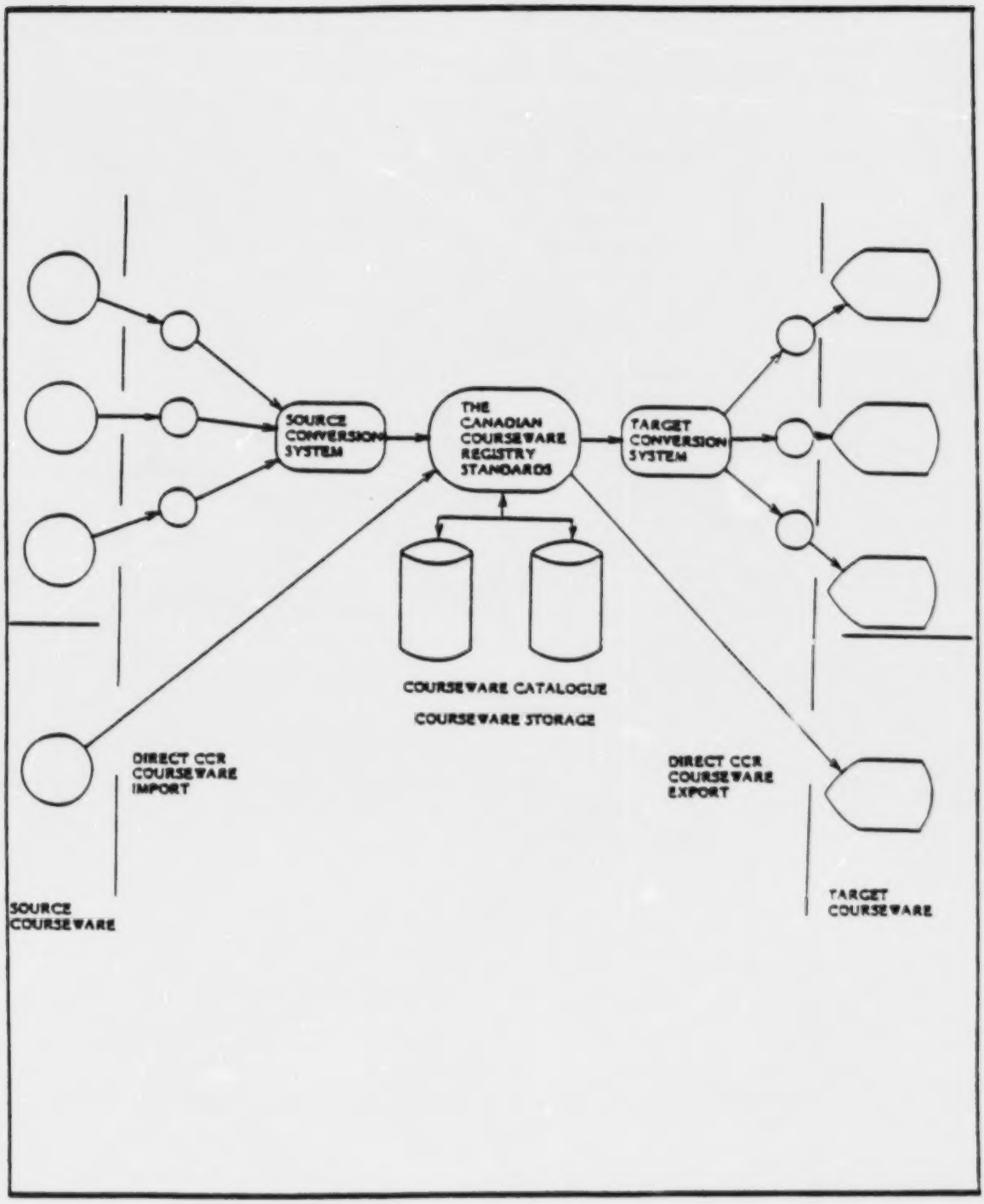


DIAGRAM 5

The Source and Target Conversion Systems are, as described in the previous section, software and people systems whose purpose is to conduct the partially automated conversion process from source and to target formats. The environment-specific tools (shown as small circles) may be used by the central group, or, perhaps, may be applied directly by the authors or users.

On the left side of the model a number of "Source Courseware Packages" are shown as larger circles. These courses, developed through a variety of authoring vehicles under a variety of equipment systems are shown entering the registry through the conversion systems, including environment-specific converters. Under the most comprehensive circumstances they are stored in original form as well as in converted CCRS form, in the minimum situation, only the course description is maintained in the registry. At the bottom of the left column are shown courses exported to the CCR in conversion code standard regardless of the original author code so that no source-to-conversion code conversion is necessary.

On the right side of the model are shown a number of target environments, consisting of hardware and software, in which users of education wish to run courses from the registry. Again, the diagram shows courses going through the conversion systems, with the exception of, at the bottom right corner of the model, some specifically designed hardware/software presentation systems that can accept courses in their CCR conversion code format - either for conversion or direct execution. It is assumed that each time a course is converted into a target environment, a copy of the converted course is also maintained.

Not shown in the diagram but inherent in the model is a central network management system that provides, as an option, for the receipt or delivery of courses through telecommunication.

In summary then, the Canadian Courseware Registry Support System includes the following sub-elements:

- Central Database Management System
- Central Network Management System
- Central Accounting System
- Source and Target Conversion Systems

CHAPTER 5

THE COORDINATED CAL INDUSTRY SUPPORT PROGRAM

The elements of a Canadian CAL Industry Support Program provided by whatever combination of Public and Private Sector initiative is required, are as a minimum:

- A Canadian CAL Support Centre
  Walk-in centre(s) providing information, expertise, and the opportunity to sample equipment, courses, and software.

- A Canadian Courseware Author and User Training program
  Sponsoring people and development programs to ensure adequate training in the various authoring vehicles for authors, and CAL usage training for educators.

- A Canadian CAL Industry Subsidy program
  A program of financial support, such as grants and subsidies, to provide assistance for start-up companies in the CAL industry, and for major expansions of existing companies. Emphasis would be on courseware development.

- A Canadian CAL International Marketing program
  A "Canada Inc." marketing initiative to market Canadian CAL products (with an emphasis on courseware) on a country-to-country basis, as well as in the open international marketplaces.

Other elements will be identified over time, as new opportunities and constraints present themselves.

CHAPTER 6

THE COURSEWARE DEVELOPMENT PRODUCTIVITY PROGRAM

Under a general Productivity Improvement Program at least three projects could be launched to greatly improve the productivity of the courseware creation process including:

1 - A Courseware Development Methodology Enhancement and Documentation Project.
Here the proven architecture based application development methodology, used in the general data processing world, would be enhanced and documented for the CAL Industry. The methodology focus is on overall productivity of the courseware/curricula creation process rather than any one aspect of the process.

This methodology would be a key element in the Author Training Program listed under the program of Chapter 5.

2 - New Utilities for Existing Authoring Languages Project.
This project would produce new authoring tools, such as enhanced editors, for existing popular languages.

3 - New Authoring Vehicles Project.
This project would produce new tools for courseware authoring that take advantage of new insights in the user-system interface requirements. For example, one tool would allow authors to communicate to computers through "do as I do" dialogues rather than explicit procedural language commands. This tool would be especially useful in the industrial environment where many simple units of "adequate" courseware are to be produced quickly and cheaply by authors who have minimal training and experience.

SECTION 3 - TECHNOLOGICAL FEASIBILITY

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INTRODUCTION

Section 3 of this report describes three major programs:

1 - The Canadian Courseware Registry
2 - The Coordinated CAL Industry Support Program
3 - The Courseware Development Productivity Program

Associated with each of these programs are a number of technical feasibility issues which must be resolved before the program can be fully implemented. These issues are described in each of Chapters 1 to 3 of this section.

It must be noted that the objective is not to resolve the feasibility issues raised. The objective is to identify the steps required to resolve each issue, and to examine the potential impact of each on the overall strategy. (Note: Stage I of the three-stage Industry plan proposed in Recommendation 4.1 (see Section 5, Chapter 4) includes, as one of its most important activities, the required feasibility analysis of the issues raised in this section.)

Chapter 4 of this section will be of interest only to those readers requiring more discussion of the technical issues surrounding this report. It contains several "Detail Notes" relevant to the technical feasibility issues.

CHAPTER 1

THE CANADIAN COURSEWARE REGISTRY -- FEASIBILITY ISSUES

There are several technical feasibility issues associated with the Canadian Courseware Registry and the model of the courseware support system described in Section 2. **(Diagram 5)**

Most of these questions can be combined into the following major issues:

A - What can and can't be stored in the Registry

Can a common form really be devised that can file and store for future use all courseware, no matter how diverse the educational strategy, the media used, or the authoring language within which it was developed?

B - What can and can't be converted technically

Is it really possible to keep on a central registry a mixture of courses authored in different languages, written for different computers, and utilizing different display media, and to convert with substantial computer assistance those courses so that they can run in specified operating environments? And can conversion be applied retroactively to courses written before new conventions or standards were in place?

C - What kind of services could be practically offered

Could a truly useful query system really be available on an on-line basis; could such a registry be properly maintained; and how can authors be protected from piracy, plagiarism, and loss of credibility because of registry errors?

Each of these three feasibility issues are briefly discussed below.

A - WHAT CAN AND CAN'T BE STORED IN THE REGISTRY

The issue

Without reference to the economic viability of a full-service CAL registry, is a global registry technically feasible? The full implementation of the registry, as described in Section 2, is one in which any courseware placed into the registry by an author can be maintained in computer-based storage, to the

CANADIAN COURSEWARE REGISTRY SUPPORT SYSTEM

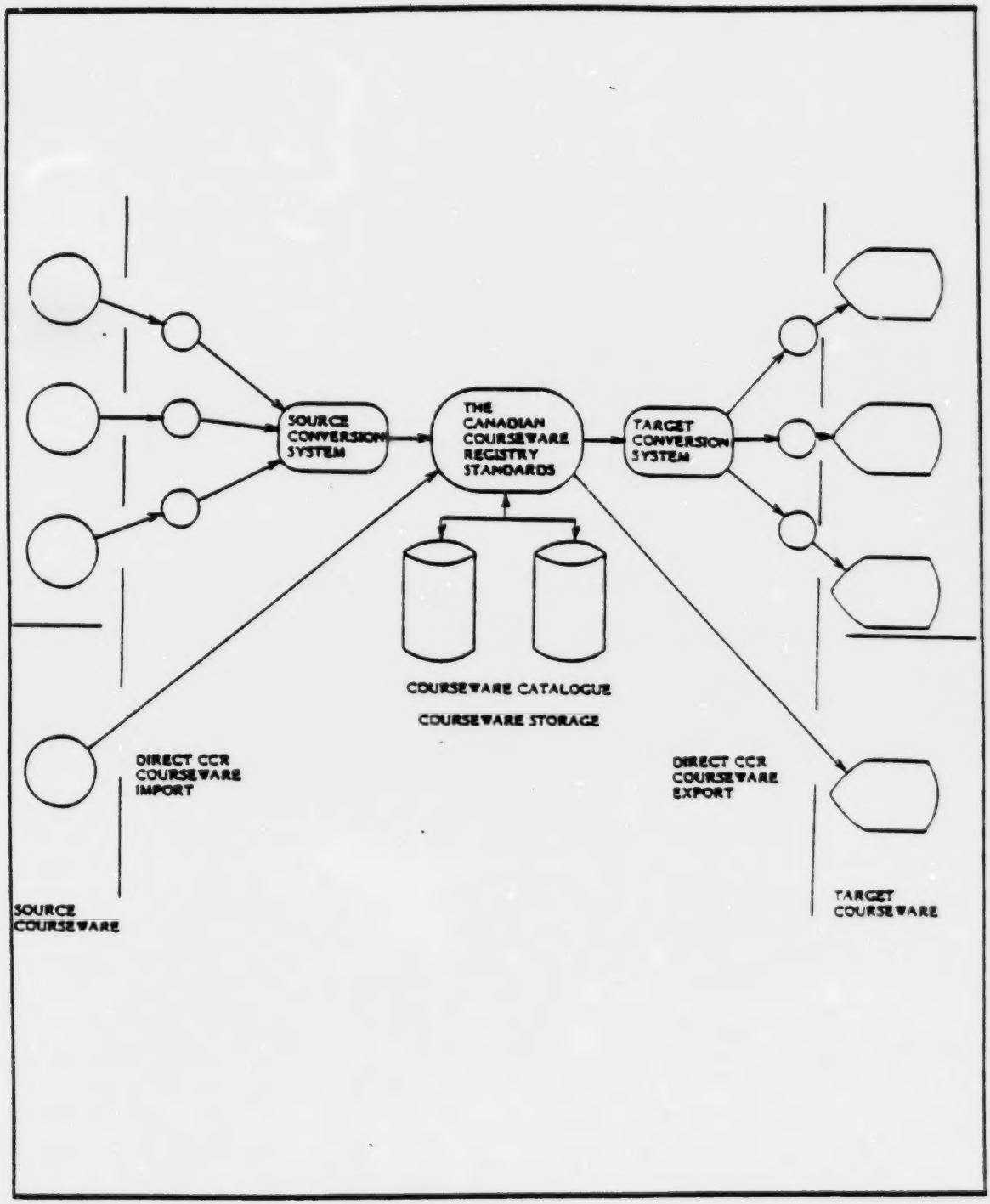

DIAGRAM 5

extent that users can access and run that course, or can arrange to have it electronically delivered to their own computer environment.

This is indeed a tall order, particularly considering the following factors.

Presentation media

Depending on the sophistication of a course and the equipment available for authoring, there are many forms of media which can be used to present a course besides the terminal screen. These include, for example, videotape, textbooks, slides, pictures, and voice cassettes. In the future, besides devices such as optical disks, choices may extend to holographic disks.

Graphics and animation

Another aspect of presentation is non-static presentation, in which timing is as much an issue as reproduction in presenting material. Animation and time-sequence graphics are examples of this area (although protocols such as Telidon have reduced the problem of this form of storage and presentation).

Course logic

Even the most primitive of page-turning courses include some level of programmed logic which decides what to present next, based on actions of the student.

Human-driven course elements

Many, if not most, courses assume, at a minimum, that a teacher or guide is available for student assistance and, at a maximum, there is human presentation of materials between computerized modules. Since teachers are difficult to store on computer media, the question becomes one of whether sufficient teacher instructions are storable.

Comments

Although there is a strong argument that all elements of courseware can eventually be captured on storage media and communicated from location to location in digital form (see Chapter 4 Detail Note "Courseware as Dataware"), the design of the registry system need not be based on this as a requisite, especially since it would be some time before complete digitization was feasible.

The degree to which the various elements of courseware (logic, instructor materials, media, animation, etc.) can be digitized and reproduced depends largely on the courseware development methodology and the modularization of materials (See Chapter 4 Detail Notes "Courseware Modularization" and "The Knowledge Base Approach"). The vast majority of material in the marketplace today, unfortunately for the quality of education (and fortunately with respect to this issue) is in the form of a program which can certainly be stored, but could only be utilized within a hardware/software environment exactly compatible to the one within which it was developed. The more sophisticated the materials, however, the less storable are those materials, precisely because techniques for developing truly modular courseware have rarely been used.

Therefore, the assumption is that the registry will not be able to store everything about every course in digitized format. The problem is simply resolved through two approaches:

1) The registry will maintain, where appropriate, as part of its "database", materials in the form of video and audio cassettes, slides, hard copy, pictures, texts, etc., and will deliver such materials by mail or courier rather than through electronic means.

2) The registry may not at first provide full storage facilities, instead classifying courses as "storable" or "non-storable". In the case of non-storable courses (and at any time that an author opts for this approach) , the registry "takes an order" for the author and passes the order to the author. Over time, based on gradual upgrade of these facilities, the registry will increase its service in this regard, so that fewer and fewer courses become "non-storable", particularly those courses which would be developed under new courseware creation methodologies (See Chapter 4 Detail Note "Courseware Registry Storage Levels").

Impact

As can be seen from the above, this technical feasibility issue has little impact on the overall registry scheme, but rather on the degree, over time to which automation of its services can be achieved. Even the Level 1 Registry described in the Detail Note "Courseware Registry Storage Levels" provides a viable and much-needed service, and this level is not affected by any technical feasibility issues.

Resolution approach

The resolution of what can and cannot be stored in digitized form requires analysis in conjunction with the planning process for the registry itself. Specific feasibility studies should be initiated during the early phases of implementation of this report.

CANADIAN COURSEWARE REGISTRY SUPPORT SYSTEM

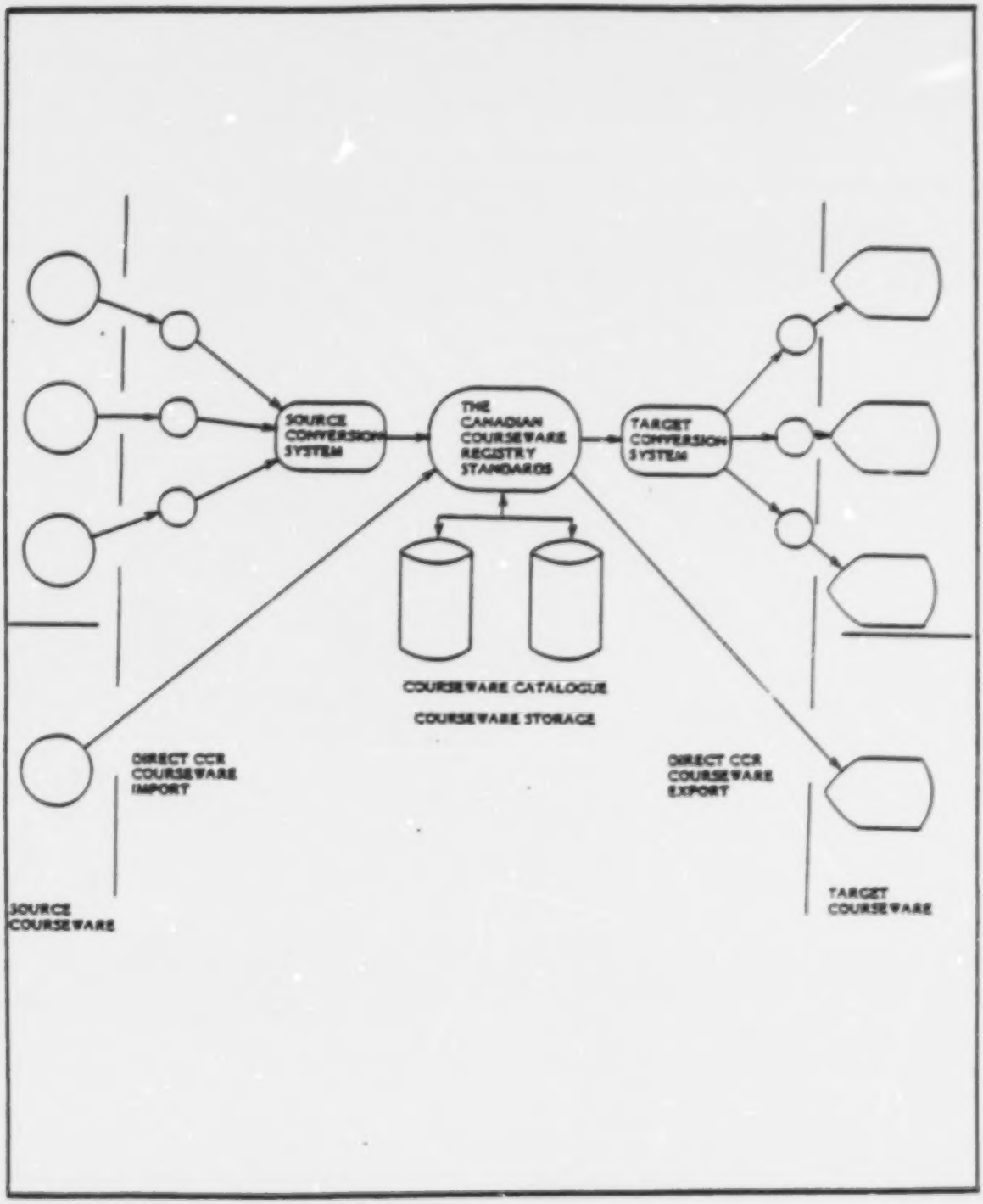

DIAGRAM 5

B - WHAT CAN AND CAN'T BE CONVERTED TECHNICALLY

The Issue

The Courseware Registry model, reproduced as **Diagram 5** refers to two major conversion systems, the "source conversion system" which converts courseware from its source form to a Canadian Courseware Registry Standard (CCRS) and a "target conversion system" which converts courseware from the CCRS to computer-ready format for designated hardware/software systems.

The feasibility issue is simply stated: Can this be done? Is it possible to take a course written twelve years ago and to convert it into some new format that is so standard that it can be transported to other computer environments? Other issues include the question as to whether it is also possible to transport presentation language on an automated basis (e.g. French to English) and media (e.g. done originally on videotape, can it be translated to optical disk?)

Comments

There is no assumption in this report that media can be automatically converted. It is assumed that something done on slides can only be displayed through a slide projector and videotape cassettes can only be played on videotape recorders (although it may not have to be stored as videotape). Furthermore, although materials prepared for a certain size display screen can be displayed on a smaller screen or a larger one (provided that paging and scrolling facilities are available), in many cases the instructional design of the material would be perverted in the conversion.

On the other hand, it is highly feasible to automatically convert material prepared in any authoring language whose compiling capability adheres to certain modularization and code generation standards to a well designed CCRS. And it is also feasible to automatically convert from a CCRS to any hardware/software environment for which a CCRS interpretation program has been written for presentation of courseware. Furthermore, there is probably some level of conversion that can be performed, for media that can be digitized (see Issue "A" above), across some

boundaries (e.g. from videotape to film or optical disk, from slides to hard copy or transparency, from one form of video cassette to another).

It is most probably not feasible to directly convert courseware on a fully automated basis that was not developed or compiled according to standards that are compatible with the CCRS. On the other hand it is possible to develop conversion tools associated with a particular authoring language and hardware/software environment, that will greatly assist a labour-intensive conversion effort. As an example, it is certainly feasible to develop a Tutor-to-CCRS conversion aid that could reduce the total conversion effort for most courseware written for Tutor (which is the authoring language for Control Data's Plato system) to a small fraction of the cost of rewriting that course.

Some additional information about the conversion process is provided in the Detail Note "The concept of intermediate conversion" in Chapter 4.

Impact

The concept of being able to run CCRS courseware on any system which has a CCRS interpreter is fundamental to the value of the Registry. Therefore, in the long run, it is vital that courses be available in the CCRS format. Courses written after the adoption and marketing of that format can, of course, be compiled into that format or, given rewritten compilers, converted to it. The problem is limited, therefore, to the backlog of courses which are already written.

Since the registry, as described in Section 2, can maintain courseware in both CCRS and original source code, it is assumed that many courses will be stored only at levels 1 or 2 (see Detail Note "Courseware Registry Storage Levels") and therefore not eligible for target conversion. In other cases, where a large volume of courses exist in a particular authoring language, it will pay to develop conversion aids. In any event, it should be up to an author as to whether the course is converted, since the labour intensity of such conversion will vary.

In the final analysis, the degree to which automated or computer assisted conversion to the CCRS is feasible affects the overall level of service of the Registry with respect to the already-written inventory of CAL courseware. It has little impact on future courseware compilation software which can be written with the CCRS standard as its target.

Resolution approach

The resolution of feasibility issues concerning source and target conversion must be studied in conjunction with the design of the CCRS. Specific feasibility studies should be initiated during the early phases of implementation of this report.

C - WHAT KIND OF SERVICES COULD BE FEASIBLY OFFERED

The Issue

Although other users and uses of the Registry are discussed in the Detail Note "Courseware Registry Storage Levels" in Chapter 4, the primary use of the Registry is for authors to market their courseware and educators to find courseware.

From the point of view of the user, the system is only as good as its classification and rating scheme, and its query system. Since highly sophisticated and useful query systems have already been proven as feasible, the major feasibility issue is: Can a good classification and rating scheme be implemented?

From the point of view of the author, a number of concerns must be addressed: Will the accounting system ensure me the royalty I ask? Is there any protection against piracy or plagiarism? Can I get feedback from users on the value of the courseware and of potential enhancements? If I store the course on the Registry, how can I maintain and change it? Will the classification method properly market my course?

Assuming that accounting methodologies have been proven in the past, the major remaining feasibility areas to be examined are the classification method, and the issue of courseware protection.

Comment

The courseware classification scheme should probably be a combination of a standard subject classification approach and a keyword-driven method. This should not be a major problem, but issues such as who does the classifying, and to what degree is subjective course rating applied must be fully addressed at some time.

The issue of courseware protection is more difficult to address. As long as the author handles delivery of courseware himself, he has some basic capability of protecting his code (although by so doing he reduces the

flexibility of usage of the course and therefore reduces his market), but it should be understood that few courseware authors have the skills to protect against copying, and many pirates have the skills to overcome almost any form of protection.

Therefore the ideal situation is one in which the Registry, rather than being a security concern to the author, is able to offer an enhanced level of courseware protection. Technically, the Registry is in a position to develop reasonable safeguards so long as it has control of delivery of the courseware, particularly once an online network exists. A courseware protection design project should be able to yield fine results in this area. Total protection is probably impossible without incredible inconvenience to the education user, and the most efficacious way to ensure that authors receive due compensation is more likely to evolve from changes to the economic basis on which authors of courseware, software, music, and other "ethereal goods" are paid, considering that today's copyright and royalty model does not do the job for this type of goods.

Impact

These issues are critical to the success of a Registry, but there is little room for doubt concerning the tehnical feasibility of a classification scheme, a query system, or a royalty accounting system. Although total courseware protection may not yet be fully feasible, a level of protection well beyond what authors have today should be attainable without excessive cost.

Resolution approach

Feasibility of the classification scheme and the software protection approach must be addressed in the early stages of the project. The classification scheme is required for a level 1 registry, while the software protection approach must be available by level 3.

CHAPTER 2

THE COORDINATED CAL INDUSTRY SUPPORT PROGRAM -- FEASIBILITY ISSUES

The CAL Industry Support Program consists of many elements, some of which will surely be identified only in the future, as the CAL strategy is implemented. Some of the currently identified elements of such a program are:

- A CAL Support Centre program
  - Walk-in centres providing information, expertise, and the opportunity to sample equipment, courses, and software.

- A Canadian Courseware Author and User Training program
  - Courses and Training programs to ensure adequate training for authors and future authors in courseware design, authoring languages, authoring methodologies, the CCRS, and other topics relating to the CAL Industry;

  - Courses and training programs on CAL selection, application, and usage for educational and industrial users of CAL courseware.

- Industry Incentive programs
  - Incentives for people within the CAL Industry, as well as users, researchers, and Governments in the form of subsidies, free assistance, tax shelters, and other forms for encouragement of activities that further the industry and the Canadian CAL strategy.

- A Canadian CAL International Marketing program
  - A "Canada Inc." marketing initiative to market Canadian CAL products (with an emphasis on courseware) on a country-to-country basis, as well as in the open international marketplaces.

For the most part, these programs offer no technical feasibility issues; rather they require political and economic feasibility analysis.

The one exception to this statement might rest in the implementation of a CAL International Marketing program, because the storage and delivery capabilities of the Registry might play a key role, particularly in country-to-country marketing. In the same way, the issues discussed in Chapter 1 concerning conversion between the

CCRS and source and target courseware apply, with added questions concerning the feasibility of automated language translation.

For broader discussion of these issues, see Chapter 1 and the Detail Notes of Chapter 4.

CHAPTER 3

A COURSEWARE DEVELOPMENT PRODUCTIVITY PROGRAM -- FEASIBILITY ISSUES

There are many technical feasibility issues associated with the courseware development productivity program described in Section 2. Generally, it recommends research and development in three areas:

- A new courseware design methodology
  A knowledge base centred method of courseware design in which content presentation is modularized and segregated from coaching and direction strategies.

- Enhancement of the courseware development process
  An approach to organizing and conducting a courseware development project (whether an individual or a team) for maximum productivity, quality, and design integrity.

- New design and authoring tools
  New tools, methods, and utilities to support the design and development methodologies, to generate CCRS compatible courseware, and to enhance existing popular languages.

Issues concerning each of these aspects of a Courseware Development Productivity program are briefly discussed below.

A - A COURSEWARE DESIGN METHODOLOGY

Not unlike the fields of computer programming and of education, the two "parents" of CAL, the technique of developing courseware has evolved in an ad hoc fashion. Because of its evolutionary nature, the original perspectives of what CAL is, have altered very far from the apparent axioms of computer programming and the traditional field of education.

In the same way as the automobile which still tends to resemble its forefather, the horseless carriage, CAL is only now beginning to move away from its original design constraints and to adopt a perspective based on what it really is; static knowledge bases utilizing multiple options for presentation, and surrounded by coaching and direction vehicles.

Knowledge base centred CAL implies a design integrity, modularization, alterability and portability which is not available within the design strategies of CAL systems today (with the probable exception of NATAL). A methodology based on this design approach can have an order-of-magnitude impact on the productivity of courseware development and on its longevity. By allowing for separation and coordination of the roles of content expert, educator, media expert, and teacher it can strongly impact the quality of education, and involve many more people in its preparation, a true requisite for the use of CAL in industry.

For a description of knowledge base centred CAL see the Detail Note "The Knowledge Base Approach" in Chapter 4.

The technical feasibility issues

Is such a method feasible today, in terms of the tools and utilities required to support it? Is the approach such a departure from traditional educational approaches as to discourage or handicap the trained educator? Can this approach implement any style or content, or will it have an impact of reducing the scope of what can be developed, and eliminating opportunities for educational creativity?

Comment

The majority of strong CAL authors who have moved off drill and practice type courses have migrated towards this form of design strategy, and this despite the absence of real tools to support it. There appears to be very little of a technical nature to block the implementation of knowledge base CAL, and there is certainly no limit placed by it on the style of presentation, coaching, or direction.

The feasibility of this approach probably hinges most on the ability to separate presentation environments from development environments, and to design a presentation environment in which such facilities as browsing, query, and simulation are built into the system, along with the capability of interpreting CCRS code.

Such capability, although not prevalent in CAL today, is already in place within other computer applications, such as online administration systems. Therefore there is little technical feasibility to prove, once an ideal CAL implementation has been identified.

Impact

Whatever technical feasibility issues there are that surround this approach, they must be resolved fully in order to

implement the recommended courseware development productivity program. Therefore particular attention should be paid to identifying problems in this area and resolving them.

Resolution approach

The most appropriate way to study the feasibility of this approach is to launch a specific feasibility study in an early phase of the implementation of this report. The study should result in one or more papers which would then be circulated to the CAL research community for further analysis and feedback.

B - ENHANCEMENT OF THE COURSEWARE DEVELOPMENT APPROACH

Courseware development, as a discipline, tends to stagger between two extremes, one being the naive bottom-up ad hoc approach which has produced much of the poorer material on the market today, the other being a full-blown top-down step-by-step approach that sometimes produces quality education at ratios as high as 200 or 300 hours per hour of courseware.

The knowledge base centred design methodology discussed above has implications concerning the development process but, even without this stimulus, there is a real need for improved productivity approaches.

With the appropriate tools, it is possible to apply some of the techniques which have recently emerged in other areas of computer technology, particularly the architecture and iterative development processes, in which an early prototype is produced as a model of the product, and, through an iterative process rebuilt into a high-quality end product. It has been found that the early feedback of such an approach actually enhances the normal top-down processes. As an example, the decisions as to the audience, objectives, and educational strategy can often be made more effectively as the result of interaction with the model.

Particularly considering the requirement in industrial training for a role split between the content expert and the courseware designer, improved CAL development project techniques must also address the modularity of development roles.

The Technical Feasibility Issues

Whenever two different fields "marry", such as education development and computer application development to produce CAL, there is always a danger that one will impose methods that are incompatible with the other. Therefore, there is a necessity to prove the feasibility of using architecture and iterative development in the field of CAL.

Comment

Many of these techniques have already been utilized in industrial training, normally in the area of computer-oriented training (that is, training whose subject matter is itself a computer application or tool). No one has really seriously measured the resulting quality or productivity.

Impact

If the recommended approaches were to prove unfeasible, it would be necessary for research and development to define other approaches. A Canadian CAL strategy must include an order-of-magnitude improvement in authoring productivity.

Resolution approach

The most sensible approach to proving the feasibility of these approaches, once they have been spelt out as part of a design project, is to pilot them through CAL development in several different environments. These steps should be taken early in the implementation of the strategy.

C -NEW DESIGN AND AUTHORING TOOLS

Given a new courseware design methodology and new development methodologies, it is clear that new tools are required to support them. In a rough analogy to the field of Data Processing, knowledge base centred CAL requires tools closer in nature to data base management systems tools than to the traditional programming languages compilers, and iterative CAL development approaches require design aids closer in nature to modelling and prototype tools than to structured design tools.

The Technical Feasibility Issues

Can such tools be developed? Would they work in a CAL environment? Could they produce the type of productivity gains being sought without ill effect on quality?

Comments

On the issue of whether such tools can be developed, there is little doubt. The same type of tools are in common use today in the field of developing other forms of application. The issue as to whether they would have the same productivity impact on CAL as they do in other fields, and as to whether they would have positive or negative effect on quality does require more proof than exists today.

Impact

If tools to support the new design and development methodologies cannot be produced, the overall impact of the new methodologies would be very much reduced, as the existing languages and tools do not support them.

Resolution approach

The best way by far to resolve this issue is to develop prototype tools to demonstrate how they would operate. Only then could educators and trainers comment concerning their impact. Because of today's prototyping technology, the process of producing such prototype systems would not be costly, and could be performed very quickly once a project were initiated. Such a project should be undertaken during the earliest stages of implementation of this strategy.

CHAPTER 4

DETAIL NOTES

This chapter contains five "detail notes", which are short articles relevant to the feasibility issues discussed in the previous chapters. They are:

A - Courseware as Dataware
B - The Knowledge Base Approach
C - Courseware Modularization
D - Courseware Registry Storage Levels
E - The Concept of Intermediate Conversion

The material in these notes is not comprehensive nor is any attempt made to "prove" feasibility of the issues raised in Chapters 1 to 3. The purpose is simply to provide some additional insight into the topic matter.

DETAIL NOTE A

COURSEWARE AS DATAWARE

Talking about courseware as dataware (see Section 2) often causes consternation amongst people in the CAL field. This is for several reasons:

> Most computer-oriented people in CAL come from a background in which CAL was seen as programmed logic (that is, as a program application) rather than as data. This has been borne out by the fact that most of the early authoring languages were essentially programming languages, and today many courses are written in programming languages such as Basic.
>
> Many educators have been annoyed at the notion that CAL was "simply another computer program". The concept that it is data is at first even more annoying because the message seems to imply that the only aspect of the course that counts is the content, and that all of the instructional and coaching technique, progress-driven presentation strategies, and motivational aspects count for nought. One often hears the statement "you can't just reduce education to so much data".

These attitudes arise from a less than full understanding of what data is. For example, it took the computer industry decades before it learned to take out of programs much material that was data, such as the commission rates in a salesman compensation program, and the editing rules for an order entry program. Once the variable aspects of computer systems, representing human decisions, knowledge, time-affected items, were removed from programs and became separately updatable files, productivity improved dramatically, the computer systems' longevity doubled, and users were able to control their own destinies without depending on computer professionals.

Even programs are considered to be data in certain contexts. For example, a compiler is simply a program that treats programs as data. When a program is sent along communication lines to a distant location, it is simply treated as so much data by the communications hardware and software.

In **Diagram 3**, data is divided into "data bases", "information bases", and "knowledge bases". Each of these types of data are described, and CAL is clearly knowledge bases, because it is a collection of knowledge. The fact that the programmed logic that presents the knowledge is stored with the knowledge in no way detracts from its status as knowledge.

Information is information, whether the logic that converted it from data is applied at the time of retrieval or whether it was pre-applied and only the results stored. It is this facet of computing that is very important in considering CAL as data.

What of the educational philosophy behind a course, and the instructions to teachers as to how to help present the course? The fact is that if the course had no CAL element whatsoever, it could be stored as data. The proof of this is that if an educator were asked to describe in full every word that they lectured, and every thought that they had while they lectured, then, having described this, it could have been recorded (by voice, or by film), and then it could have been digitized and stored as data.

Thus, the only issue between a CAL course and a non-CAL course, both stored as data, is: for how much of the data is the audience (that is, the user of the data) another teacher, and for how much of the data is the audience the learner.

What about non-computerized materials, such as slides, and pictures? Not too long ago, voice, graphics, and animation were considered non-computerized. Before that, even text was considered non-computerized. If one considers, say, a diagram on an overhead projector transparency, one can insist that there is no way to store an overhead transparency on a computer . On the other hand, one can store the diagram represented by the transparency as well as a program that can plot out that diagram, instructions as to how to colour that diagram, and instructions to someone as to how to make an overhead transparency. In fact, a program could be written to operate a transparency-making machine, and cut out the middle person. Eventually everything from film to puppet will be storable as data, through the simple device of capturing its essential form digitally and instructing a machine on the receiving end as to how to convert it to a hard medium such as puppet.

A CAL course, then, is data, whether at the lessonware, courseware, or complete curriculum level. The issue concerning the storage of educational material is not one of what can be stored, but simply one of how much of the entire course, including instructional philosophy, instructions for how to create a slide, or quizzes and songs will be reduced to storable data.

Furthermore, CAL results specifically in knowledge bases, as opposed to data bases or information bases, because its purpose is to impart knowledge.

PENETRATION OF THE DATA MARKET

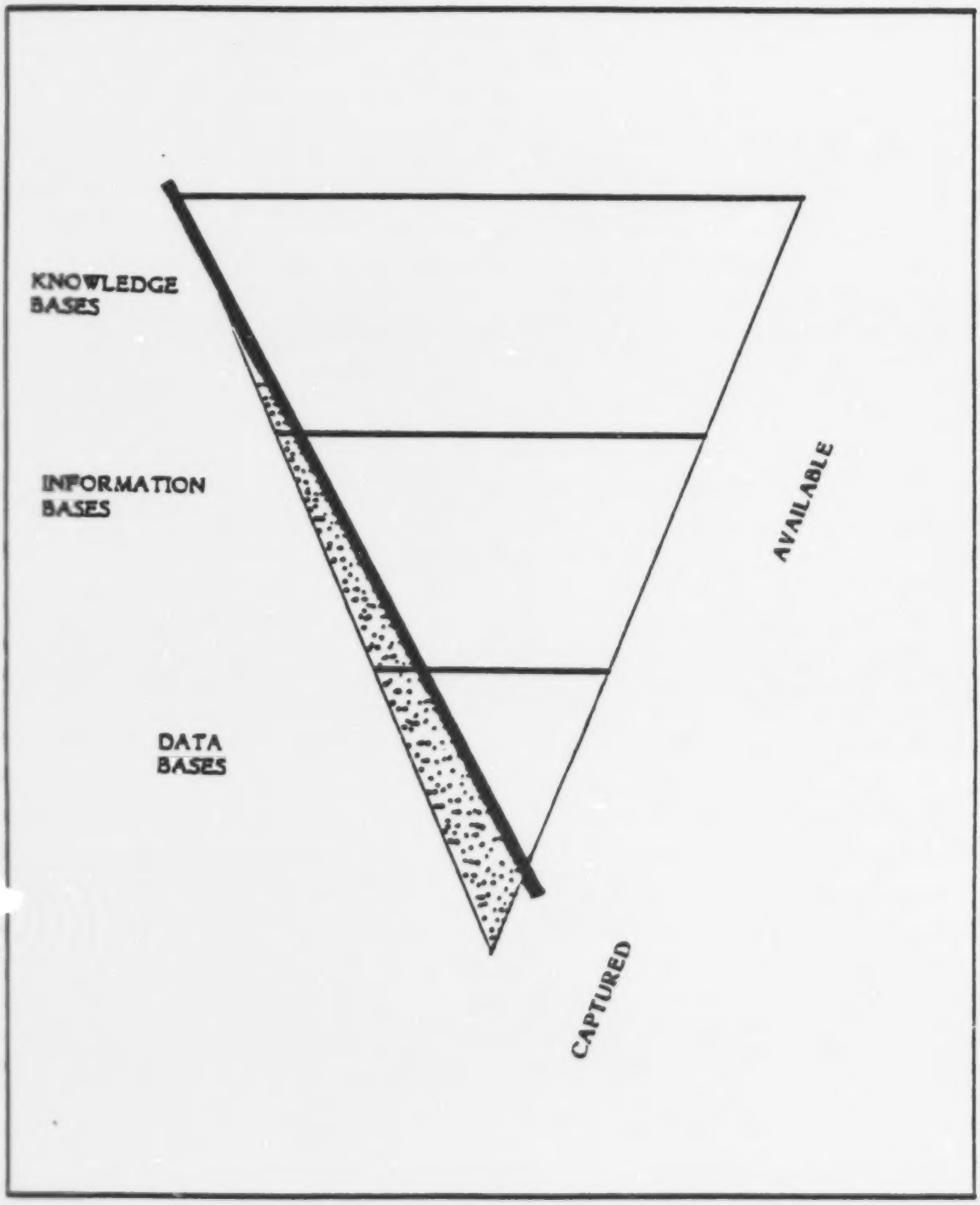

DIAGRAM 3

THE THREE CAL ENVIRONMENTS

1 - DIRECTED

The learner is following a specific course plan with a fixed sequence, although the sequence may be dynamically selected, based on performance. The system directs the student what to read or watch, or presents him with specific displays of information, followed by questions/quizzes/games, etc., followed by more information. The learner does not choose what to do next. The system or teacher does.

2 - UNDIRECTED

The learner is provided with a "learning environment", which may include a number of sets of information presentation, in one medium or another, games and quizzes, a general glossary, bibliographies, checklists, and lists or menus of what items are available. The learner is permitted full freedom in selecting which items to use, and when.

3 - COACHED

The learner is provided with a "learning environment", as well as "coaching", which may be provided by humans or the computer system itself. In either event, the most normal implementation is one in which the learner can go to the "coach" for advice as to what to do next, and the "coach" maintains a checklist of items to be accomplished and what has been accomplished to date. The list may be used as success criteria for the one form or another of certification for the overall course of study, or may simply be another tool of the learner. Generally, coaching involves some form of "test". The test may be built into the activities which the learner can select, or may be offered the learner as part of the coaching process.

DIAGRAM 6

DETAIL NOTE B

THE KNOWLEDGE BASE APPROACH

Many writers in CAL have described, using one vocabulary or another, a spectrum of instructional techniques, ranging from "Directed" or system-driven to "Undirected" or student-driven. **Diagram 6** summarizes the two extremes of this spectrum, and the "coached" mid-point. From course to course and within a course, depending on audience and subject matter, the instructional strategy may and should vary.

The earliest approaches to CAL, at a time when computers were seen at best as a drill-and-practice tool, were based on that perspective, and so most authoring languages and tools are designed for a highly directed style ("teaching" rather than "learning", "CAI" rather than "CAL").

Focusing on the totally undirected learning environment, or the "knowledge cafeteria", the learner has in front of him or her what is essentially a static knowledge base plus a number of facilities for accessing that knowledge base (a dynamic knowledge base is one in which the computer system itself, through inferential processes and through accumulation of experiences, is constantly updating its knowledge; an active knowledge base is one in which the computer system is using its increasing and updating knowledge to make decisions or to drive processes, an essential aspect of artificial intelligence and robotry).

The facilities for accessing the knowledge base may be very broad, including various media of display (such as graphics and voice), various presentational strategies, (such as textual tutorials, quizzes, games, and simulations) and various strategies for locating the desired knowledge, (such as glossaries, menus, and cross-references).

In many ways the access to a knowledge base environment is quite like the typical access to a database or information base system in business. The user is given tools such as menus, query languages, browsing facilities, and glossaries to find required information whenever needed. The difference is that the presentation is usually limited in scope to text or basic graphics (with voice presentation on the horizon as another option). That is, information is provided through presentation strategies most conducive to efficient transfer of information. With knowledge bases, however, presentation strategies are ideally designed for most effective learning.

Courseware development methodologies that are based on directed or coached approaches cannot, generally, result in knowledge bases which can be used in an undirected mode. The reverse, however, is not true. By starting with a knowledge base as a central core, it is possible to add any form of presentational technique, as much coaching capability as desired, and as much direction as desired.

Diagram 7 illustrates the layers comprising a knowledge base centred CAL system.

First, there is a core of knowledge, organized on some logical basis for effective access. Each substructure of knowledge has associated with it at least one presentational vehicle.

The next layer is "coaching" facilities, comprising learning checklists, pointers to topics for specific learning objectives, progress tests, and other coaching strategies. Any number of coaching modules can be added to a single knowledge base, for different subsets of the base, for different subsets of the base, for different audiences, or for different learning objectives.

The final layer is "direction" facilities, which provides for complete system-driven learning experiences.

This concept of knowledge base centred CAL, though feasible to implement using some of today's CAL tools, is not specifically supported by any particular tool. A CAL methodology supporting the approach would have a number of specific features, such as:

- Total separation of development and presentation environments.

- Ability to separate knowledge input and structuring from presentation, coaching, and direction specification.

- Many automatic features built into the presentation environment, as underlying "services". These would include paging and scrolling, fast menu selection, a query and keyword capability, and powerful browsing facilities.

- Powerful knowledge organization tools

- Rules driven logic specification.

This knowledge base centred approach is particularly critical to industrial training and large-systems environments, because so much of training must also be used on demand and on the job. Using

COURSEWARE MODULARIZATION

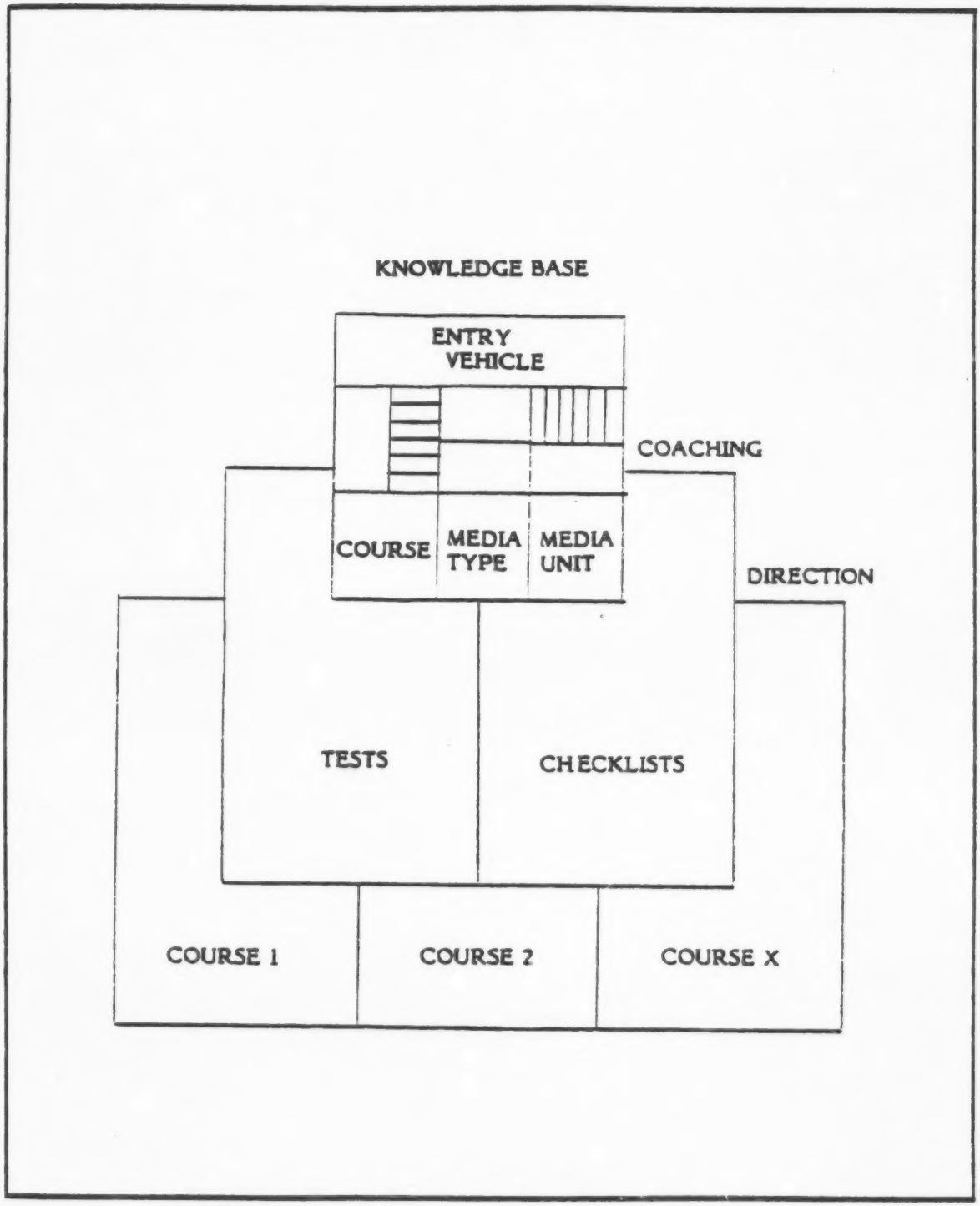

DIAGRAM 7

knowledge base approaches, a training program could be built around the knowledge base, using coaching and specialized presentation facilities, but the same knowledge base could then be referred to often when on-the-job reference is required.

It should be noted that ability to separate knowledge base and other courseware elements leads to a situation where a great number of different "courses" can be developed around a single knowledge base, for different audiences, different subject matter, and different coaching/presentation/direction strategies. Many different specialists could work around one knowledge base, some with a mission of maintaining and expanding the knowledge base, and others with a mission of teaching different aspects of the material to different audiences.

DETAIL NOTE C

COURSEWARE MODULARIZATION

Courseware modularization is often understood (and implemented in the majority of CAL systems) as a single-dimensional structuring of materials based on the standard hierarchies of non-automated educational methodology (e.g., curriculum/course/lesson hierarchies, objectives hierarchies, audience requirements, and sequence strategies such as preparation/presentation/reinformement).

In a knowledge base centred CAL technology, the educational structure of the material is only one dimension. A second dimension is concerned with content structure, and a third dimension is based on media.

Diagram 8 illustrates this modularization approach. The vertical dimension is the educational hierarchy. The horizontal dimension is broken first into knowledge base, coaching vehicles, and direction vehicles, and then further broken down within these categories. The third dimension of the CAL cube is dialogue media (displays, animation, text, voice, etc.).

These dimensions also make it possible to think of CAL as a joint effort of a number of developmental roles. These roles, which may all be played by one person in the development of a standalone course, or may each be played by a different person in the development of a major knowledge base with many curricula and courses developed around it. An example of one way to structure these major roles is:

- Subject expert
- Content author (somewhat equivalent to text-book author)
- Curriculum planner (vertical dimension)
- Course/lesson planner (coaching and direction strategies)
- Presentation designer (third dimension)

The CAL vehicles required to support this form of modularization includes:

- Standard "presentation" systems that interpret the contents of the knowledge base and coaching/direction vehicles, that have built in the standard services such as query, browse, simulate, cross-refer, etc., so that these facilities do not have to be programmed as part of the development of the courseware.

CAL CUBE

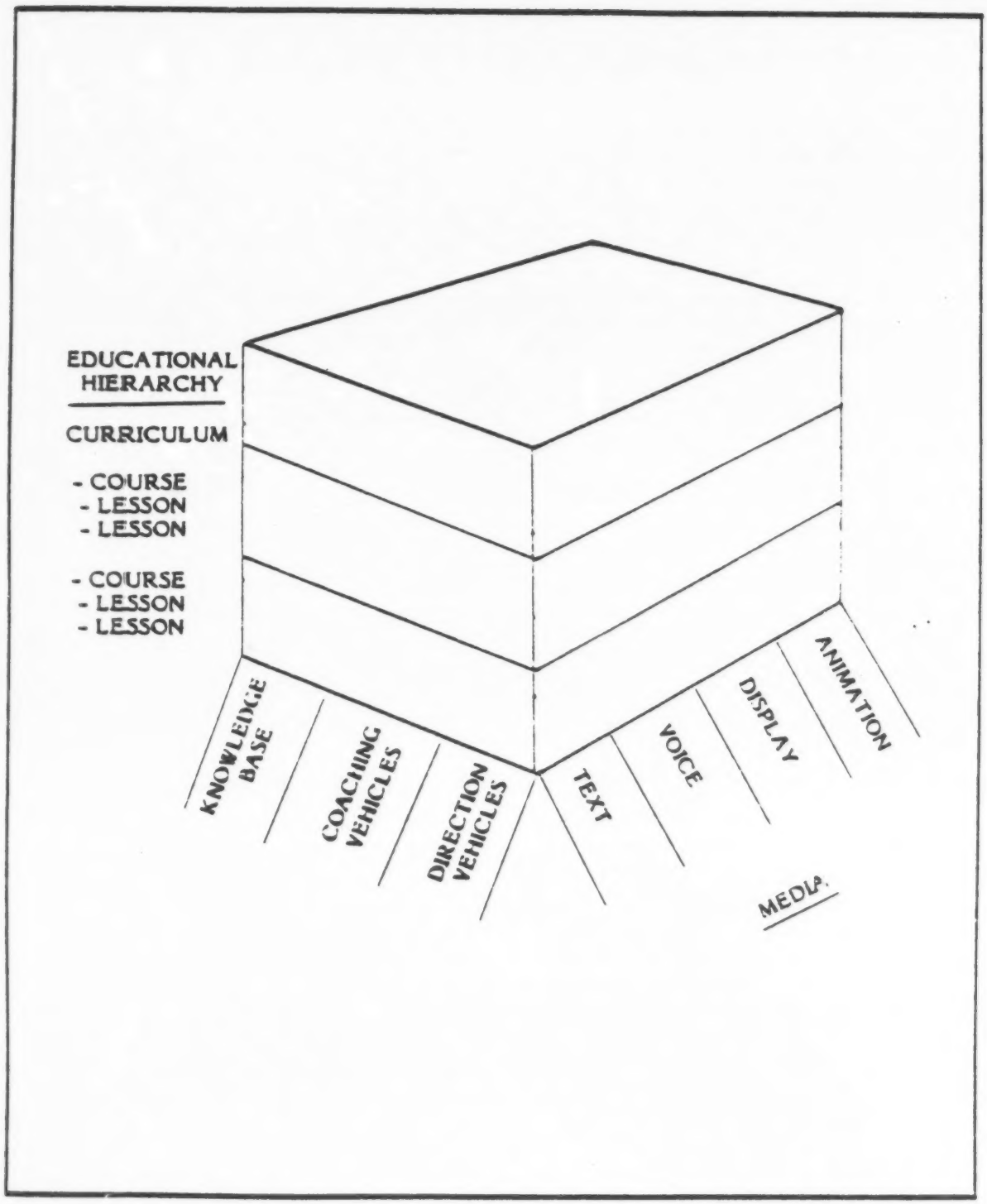

DIAGRAM 8

- A courseware development system that permits the structuring of this three-dimensional matrix of materials by one or a group of people, permitting each of the roles to be played independently.

- Authoring languages and methodologies that are consistent with courseware development and presentation systems such as are described above.

DETAIL NOTE D

COURSEWARE REGISTRY SERVICE LEVELS

The material in this note is not intended to be comprehensive, but rather to provide an overview of the levels of services which the Canadian Courseware Registry could, over time, provide. Many other services will be discovered through the operation of supply and demand forces.

THE LEVELS OF SERVICE

Four basic levels of registry are identified in this analysis:

Level 1 - Directory Service

At this level, the registry does not store, maintain, or deliver materials. It simply provides online and batch directories, so that authors can register their courses, and users can look through the directories to locate courses they require. A course classification scheme is part of such a directory, and a structured description format including author's description and such information as hardware/software environment requirements, etc. The service can be further extended to include ratings and comments provided by users and CAL critics.

Level 2 - Repository Service

At this level the registry, when requested by suppliers, stores and delivers materials to users (directly, or through facilities such as local centers), taking responsibility in addition for inventory tracking, royalty tracking, accounting, piracy control, feedback solicitation, and version control. Courses are stored in the form that they are provided by authors, with no conversions performed.

Level 3 - Conversion Service

At this level the CCRS formats are established, together with basic authoring and presentation tools and methodologies. Some source conversion systems exist and automated target conversion to those configurations for which standards presentation systems exist takes place. The registry now maintains courses in source and standard formats, provides access to existing source conversion aids, and accepts courses into the registry on an online basis.

Level 4 - Comprehensive Service

At this level many additional services are offered, along with sophisticated communications services that support electronic delivery to export markets, and time sharing services that, for example, permit users to download only parts of systems, utilizing the registry's mainframe for others, and that make extensive services available to authors and other industry participants.

A SAMPLING OF SERVICES

	Level 1	Level 2	Level 3	Level 4
COURSEWARE DESCRIPTION				
- Authors's description	x	x	x	x
- Structured description	x	x	x	x
- Classification	x	x	x	x
- User and critic ratings	x	x	x	x
- Where to get, how much	x	x	x	x
STORAGE/DELIVERY SERVICES				
- Source format		x	x	x
- CCRS format			x	x
- Conversion code			x	x
- Delivery - non-electronic		x	x	x
- Delivery - electronic			x	x
- Digitized media				x
USER SERVICES				
- Online query, finding	x	x	x	x
- Direct delivery		x	x	x
- Online tryout			x	x
- User registry	x	x	x	x
- Profile monitoring		x	x	x
- Usage tracking, accounting		x	x	x
- Services location		x	x	x
INDUSTRY SERVICES				
- Author/industry registry	x	x	x	x
- Accounting, royalty tracking		x	x	x
- Conversion facilities			x	x
- Piracy protection			x	x
- Opportunity advising	x	x	x	x
- Online aids			x	x
- Translation				x
- Export marketing			x	x
- Online registration	x	x	x	x
ADVANCED SERVICES				
- Timeshare & distributed				x
- Macros and subroutines			x	x
- Requirements/Capability exchange				x
- Curriculum-level materials				x
- CAL training materials			x	x
- Checklists for industry training				x

DETAIL NOTE E

THE CONCEPT OF INTERMEDIATE CONVERSION

Wherever there is a need for the conversion of materials from one of many formats to another, for example spoken language translation, programming language translation, or storage format translation, the concept of intermediate conversion applies.

At its most basic level, the concept is as follows:

> Suppose, for example, one wishes to translate materials written in any of 30 spoken languages to any other. Direct translation would require a total of 435 translation programs to be written (assuming one translation program can convert from language x to language y, and from language y to language x). That is, if there are N languages, then a total of (N x (N-1))/ 2 translation algorithms are required.
>
> On the other hand one of these languages, or yet another language could be identified as an intermediate language, and the process of translating language x to language y could be defined as a two-step process: Translate x to Intermediate Language. Translate Intermediate language to y. In that event, only 30 translation programs would be required (assuming that each translation program translated from a language to the intermediate language and from the intermediate language to that language). That is, using the two-step Intermediate Language strategy, if there are N languages, N translators are required.

In the intermediate conversion approach, then, a standard format (for storage, for instance) is selected not with the purpose of demanding that everything be in that format, but with the purpose of developing conversions from all other formats to that one, and therefore providing for intermediate conversion.

The CCRS is planned to provide for an intermediate conversion strategy. Given a large number of source environments (that is, the software/hardware environment in which a course is authored) and a large number of target environments (that is, the software/hardware environment in which a course will be run), such a strategy could, over time, speed the process of broadening the marketplace for CAL by orders of magnitude.

Furthermore, once a standard exists, new materials can be prepared within the standard format, or conversion tools built into the various development environments to make the process of conversion yet more feasible.

SECTION 4 - ECONOMIC, POLITICAL, AND SOCIOLOGICAL ISSUES

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INTRODUCTION

This section of the report addresses the economic, political, and sociological issues concerning the proposal for a Canadian CAL strategy.

Generally, there are three tasks that must be completed in the early stages of implementation of a Canadian CAL strategy. These are:

1 - Define and measure the size of the opportunity facing Canada, were it to throw itself fully into a CAL strategy such as the one described in this report.

2 - Evaluate the obstacles to implementing such a strategy with an eye towards planning what is necessary to avoid them, and towards analyzing the risks associated with the strategy.

3 - Estimate the costs of implementation of such a strategy, for the purposes of justification, budgetting, and funding the effort.

Although the scope of this study has been too limited to seriously undertake this analysis, the three brief chapters of this section attempt to describe some of the issues involved and to identify approaches to be applied during the recommended Stage I of the project.

The fourth chapter provides a Detail Note, estimating an outside figure for net additional cost of Stage I activities.

It is most important to keep in mind that in the early stage, a business case need only be built for proceeding to Stage I, during which a more accurate assessment of potential and risk will be accomplished. To do this, the case must simply show that there is a very great potential, and some possibility of it being realized, against the cost of Stage I activities.

CHAPTER 1

MEASURING THE OPPORTUNITY

In Section 2, Chapter 1, a goal for Canada's CAL Industry was proposed, listing four sub-goals which address:

1 - Employment which could be generated by the industry

2 - Direct contribution to Canadian balance of trade through export increase and import decrease in education and training

3 - Contribution to superior Canadian education, and the competitive edge which that may provide in the Information-Centred arena of International competition

4 - Contribution to productivity and effectiveness in all Canadian industries, with resultant impact on GNP and balance of trade.

The development of a business case for a strategy such as the one recommended in this report is probably best done by measuring the impact that these goals could have on the Canadian economy, and then measuring the likelihood of accomplishing the goals.

Section 3 of the report looks at the question as to how to address technical issues concerning the implementation of the strategy, and Chapter 2 of this section looks at the same question for the economic, political, and sociological issues that may impact the feasibility of the strategy, and what is involved. The issue remaining in this chapter is what is necessary to measure the opportunity.

A - MEASURING SUBGOAL 1

The task of measuring employment generated by a CAL industry if this strategy were fully implemented is somewhat akin to measuring the potential employment that would be generated by the telephone industry, at the time that telephones were first invented. The problems are:

- Identifying what is "offsetting" employment and what is "new" employment. For example, there is reason to believe that the total number of classical classroom teachers will be reduced, and many of these people will become specialists in CAL or other advanced instructional technology fields. At first glance this cannot be counted as "new" employment; but then the next question concerns how many of these people would have been displaced in any event, if this strategy were not implemented, given population trends and economic realities

- Identifying the employment generated by second-order effects of Canada's implementation of the proposed CAL strategy. What impact does an implementation of knowledge base centred CAL have on Canada's entry into information technology on a broader scale? What of translation services, registries, and expanding adult education? What of Consumer sector courseware?

Generally, the "ball-park" approach to measuring the employment opportunity generated by domestic sales of CAL in Canada centres around measuring the public education field on a global employee/pupil ratio, and estimating future base-case employment on the basis of forecasts of student populations in the future. Since an increase of that ratio would probably be economically unacceptable to the educational marketplaces, the assumption should be that little or no increase of employment in public education can be caused by the CAL Industry. However it should be emphasized that the real opportunity is in adult education and training areas, and calculating this is simply a matter of extrapolation of potential growth in these fields.

The far larger issue is the impact on Canadian employment of a major export business in CAL. This is, if Canada could sell entire training curricula to other countries, or could triple or ten-fold increase its penetration of the training market in other areas, what would be the impact. Applying our employee - pupil ratios to developing countries and subtracting their own ratios provides some basis for estimating how much new employment in Canada could be generated if we were to assume responsibility for other countries' curriculum and CAL development. Applying the "Ten times Canada is U.S. and double that is world" rule of thumb to the estimated $3 billion industrial training expenditures (excluding off-the-job costs) in Canada produces an expected $60 billion/per year world marketplace for industrial training. This amount must be extrapolated on the basis of a curve that is climbing much more sharply than the normal inflation curve. Then it is a matter of choosing what percentage penetration CAL can achieve of industrial training and what penetration Canada can achieve of that if we adopt the proposed strategy, and evaluating its impact on employment in Canada.

Focusing on the employment of trained teachers then, the situation can be summarized as follows: In public education no major change in employment though many teachers may become CAL specialists with the classroom trends, in adult education training major employment increases and in CAL for export, almost unlimited opportunities for employment, if we succeed in exploiting that market.

This approach totally ignores the export market for the side benefits of this approach, such as natural penetration of the knowledge base industry if we have CAL based on such an approach. New opportunities to be generated by the strategy should be listed conservatively, but the big payback lies in just those zones.

B - MEASURING SUBGOAL 2

Almost the same approach applies to subgoal 2 as to subgoal 1 in terms of gathering a basis for forecasting the results of the strategy. The export market can be calculated on the basis of penetration of CAL in education and training, and penetration of Canada in CAL. Reduction of imports can be based on extrapolating today's CAL import figures, to what extent this can be identified, and assuming that Canada can double the penetration domestically that it can have world-wide.

C - MEASURING SUBGOAL 3

This area is highly subjective. One must first evaluate the impact that CAL can have on some unit of measurement of educational achievement, and must then evaluate the impact that the forecast increase through CAL can have on Canada's net economic position.

D - MEASURING SUBGOAL 4

Subgoal 4 is perhaps the largest potential impact in the long run. A study of the potential impact of a strategy on GNP and balance of trade through industry improvement is, however, not a simple job.

The process of evaluating this subgoal is one of asking and answering the following questions on an iterative basis:

- What would, for example, a 1% impact be worth on each of GNP and import/export differential?
- What would be required to happen for such an impact to be realized?
- What would the strategy have to accomplish for these things to happen, and can it do it?

Through iteration, one can come up with a range of impacts, and measure the net benefit the strategy could have.

CHAPTER 2

EVALUATING THE OBSTACLES AND RISKS

The technical feasibility of this approach, as has been discussed in Section 3, does not impact whether the strategy can be implemented; it simply affects how much of the strategy can be implemented and at what rate.

The major feasibility question centres much more around economic, political, and sociological problems. The following problems, as a minimum, must be addressed during Stage I of the strategy plan.

Economic Issues

- Can payback be achieved early enough to offload the costs of the strategy, or is this a high-risk long-term investment? If it is high-risk and long-term, can Canada afford the investment or should it look at lower payback but lower-risk possibilities?

- Can an appropriate balance of incentive and free market be struck to ensure that CAL industry participants will turn in the direction required, without becoming dependent on public handout?

- What must be done to achieve a good investment climate for this field?

Political Issues

- Is there any way to mobilize an industry that is spread in jurisdiction across Federal and Provincial lines?

- Is the Federal Government capable of mobilizing its focus through one central agency, and coordinating the efforts of the many departments that currently have some funding or other jurisdiction concerning CAL?

- Can Canada market at a country-to-country level, given our limited and not necessarily successful history in this regard?

- Will Canada be given access to export markets without running into trade barriers?

Sociological Issues

- Is the CAL industry establishment, in its current form, flexible enough to undertake new perspectives and new approaches?

- Can the educational community and the industrial communities of Canada accept the rate of change which this strategy would thrust on them?

- How will multi-national companies respond to this strategy?

- Is the public ready or can it be made ready for the level of computer-based activities recommended in this strategy?

- Can key elements of the strategy, such as NATAL, overcome the inertia which accompanied their birth?

- Can Canadian industry mobilize around the "Canada Inc." type of strategy as countries such as Japan have been able to?

CHAPTER 3

ESTIMATING THE COST OF THE STRATEGY

The third element in establishing feasibility, beyond the issues of opportunity and constraint, is cost.

Before the cost of a new strategy can be determined, a baseline must be established, which is the costs without the strategy. It is a relatively simple step to gather the current costs that Canada incurs in the field of CAL. It is a matter of toting up the annual expenditures on the various incentives and projects in the area. Alternatively, the approach can be taken of estimating total costs of education and training with and without this strategy, and considering the difference to be cost.

The point of the recommendations of this report is that great costs need not be undertaken on an "up-front" basis.

The first step is to calculate the cost of the first step, and to decide whether it is worth taking that step, based on the possibility of return that has already been identified. The activities of the first step include an exhaustive feasibility analysis, and the plan developed during that step would identify whether or not there is a case for this approach, and, if so, how large a case.

As a preliminary estimate of the first step, as described in Section 5, Recommendation 4.2, the maximum cost of the step should not exceed $4,000,000 dollars over and above the amounts currently being spent by the Federal Government in support of CAL. The Detail note in the following chapter provides a basis for this estimate.

CHAPTER 4

DETAIL NOTE

COST ESTIMATE OF STAGE I

This detail note provides a very rough estimate, subject to verification, of a maximum cost of Stage I over and above the costs which would be incurred for CAL if no new steps were taken.

It consists of two sections. The first identifies the cost elements represented in Stage I, mapped to the recommendation number in Section 5 which describes that element. The second estimates what the costs might be in the one-year period of Stage I.

A - COST ELEMENTS

STAGE I
STRUCTURE

	REPORT REFERENCE
Duration: 1 yr.	Rec. 4.1
ORGANIZATIONAL	
CAL INDUSTRY STRATEGIC PLANNING MISSION	Rec. 4.1
- Assignment to a central Government Agency, or	Rec. 2.9
- Stage I could be on managed task force basis	
- Responsibility:	
- Produce first 10-yr., 3-yr., 1-yr. plan	Rec. 4.1
- Coordinate other Stage I activities	
- Allocation of SD, SE, AH funds for the year	Rec. 2.8
PRO-TEM CAL INDUSTRY STRATEGY REVIEW BOARD	Rec. 2.9
- Group representing as many facets as possible of industry	Rec. 2.11
- Pro-tem until election of Private Sector membership	Rec. 4.1
- Responsibility:	
- Advises Industry Planning Mission	Rec. 2.9
- Reviews and endorses plans	Rec. 1.5
- Convenes first annual meeting of industry	Rec. 2.11
- Reviews and endorses allocation of SD, SE, and AH funds	
STRATEGIC DEVELOPMENT PROJECTS	Rec. 4.2
- A - Technical and Feasibility analysis of recommended goal and strategies	Rec. 1.2
- B - Specification of Canadian Courseware Registry Conversion Code Standards	Rec. 2.6
- C - Design of enhanced authoring facility for NATAL	Rec 3.7

- D -	Feasibility study and planning, in conjunction with vendors, of language interface conversion tools	Rec. 3.10
- E -	Feasibility study and specification of a distributed version of NATAL	Rec. 3.8
- F -	Implementation of a manual-only Canadian Courseware Registry, through direct survey and collaboration with existing registries and associations	Rec. 2.3
- G -	Launch Canadian CAL Industry survey, including the design of a classification scheme and the application of the scheme to the list of industry participants gathered in the survey	Rec. 2.11

STRATEGIC ENCOURAGEMENT FUNDING

- H -	Private Sector activity relevant to NATAL	Rec. 3.5
- I -	Private Sector activity relevant to identification of National Strategy or in response to strategic position papers released by Strategic Planning Mission	Rec. 1.1
- J -	Private Sector activities relevant to the Canadian Registry	Rec. 2.3
- K -	Research specifically contributing to technical feasibility analysis or solution of technical problems related to the recommended strategy	Rec. 1.2

OTHER FUNDING

- L -	Ad Hoc funding of all CAL-related activities with special emphasis on courseware	Rec. 1.4

OTHER ACTIVITIES

- M -	Negotiations concerning launching of utility activities during Stage II	Rec. 3.4
- N -	Investigations concerning market potential for export, based on a plan of country-to-country marketing	Rec. 2.4
- O -	Investigations concerning requirements for creation of an ideal investment climate for CAL	Rec. 2.7

B - COST ESTIMATES

ORGANIZATIONAL	OUTSIDE ESTIMATE
Strategic Planning Mission Basis 5 People @ $50,000 + expenses and support $50,000	$ 300,000
Pro-Tem CAL Industry Strategy Review Board Basis 10 people @ $5,000 + expenses and support $25,000	75,000
	$ 375,000
STRATEGIC DEVELOPMENT PROJECTS	
- A - Technical and Feasibility analysis of recommended goal and strategies	$ 150,000
- B - Specification of Canadian Courseware Registry Conversion Code Standards	250,000
- C - Design of enhanced authoring facility for NATAL	250,000
- D - Feasibility study and planning, in conjunction with vendors, of language interface conversion tools	150,000
- E - Feasibility study and specification of a distributed version of NATAL	150,000
- F - Implementation of a manual-only Canadian Courseware Registry, through direct survey and collaboration with existing registries and associations	500,000
- G - Launch Canadian CAL Industry survey, including the design of a classification scheme and the application of the scheme to the list of industry participants gathered in the survey	250,000
	$1,700,000
STRATEGIC ENCOURAGEMENT FUNDING	
- H - Private Sector activity relevant to NATAL	$ 750,000

- I -	Private Sector activity relevent to identification of National Strategy or in response to strategic position papers released by Strategic Planning Mission	150,000
- J -	Private Sector activities relevant to the Canadian Registry	150,000
- K -	Research specifically contributing to technical feasibility analysis or solution of technical problems related to the recommended strategy	200,000
		$1,250,000

OTHER FUNDING

- L -	Ad Hoc funding of all CAL-related activities with special emphasis on courseware	????

OTHER ACTIVITIES

- M -	Negotiations concerning launching of utility activities during Stage II	25,000
- N -	Investigations concerning market potential for export, based on a plan of country-to-country marketing	100,000
- O -	Investigations concerning requirements for creation of an ideal investment climate for CAL	100,000
		$ 225,000

TOTAL EXPENDITURES:

STAFF EXPENSES	$ 375,000
STRATEGIC DEVELOPMENT PROJECTS	1,700,000
STRATEGIC ENCOURAGEMENT FUNDING	1,250,000
OTHER STAGE I FUNDING	225,000
	$3,550,000

PLUS AD HOC FUNDING

N.B.: For simplicity's sake, all current funding programs are considered to be "Ad Hoc funding". Although some of these would fall into the other categories, it is convenient to consider the current level of industry funding in the Stage I period as applied to the "Ad Hoc" category, and therefore the other categories can be considered expenditure over and beyond what has been spent in former years.

SECTION 5 - RECOMMENDATIONS

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INTRODUCTION

This section of the report contains specific recommendations for Canadian progress in the CAL Industry, expanding on the goals and strategy described in Section 2, and providing a framework for planning and implementing the strategy and addressing the issues laid out in Sections 3 and 4.

Since no solution strategy can be implemented in its entirety overnight, nor all of the strategy feasibility obstacles swept aside, the following assumptions are built into the recommendations:

- a long-term plan is required to achieve the goals.
- the plan must provide for short, manageable steps within a larger context.
- each step must begin with a feasibility confirmation for that which is planned within the step.
- the plan must have built into it sufficient flexibility so it can be altered as the result of findings of feasibility studies, new developments in technology, industry, or Canadian environment, or newly identified opportunities.
- other activities, which are not specifically in the plan, must be supported as well, on the basis that all Canadian CAL activity contributes eventually to the industry, and that many new directions will emerge from ad hoc creativity. The plan itself, therefore, must include vehicles for ad hoc support.

Diagram 9 (opposite the following page) illustrates the three-dimensional relational framework of factors proposed for the development of the CAL Industry, within which recommendations are presented in this section.

The vertical dimension represents all the possible and proposed activities of the industry. These activities are organized into three classes, two of which (Strategic Development and Strategic Encouragement) are fully defined in this report with the third class (Ad Hoc) reserved for all activities not planned, including those which are not consistent with the recommended strategy.

The horizontal dimension represents the various Public and Private Sector participants in the industry. Some recommendations are made in this report concerning specific roles organizations could play with reference to the Strategic Development and Strategic Encouragement activities in the vertical dimension.

The third dimension represents the factor of time. This report recommends that plans include three time-ranges, short-range (1 year), mid-range (3 years), and long-range (10 years) over which the participants would carry out activities in the three classes.

Within this framework, then, one can imagine each of the small cubes to represent the specific activity of a specific industry segment or organization within a specific time-frame.

Based on this framework of activities carried out by participants over time, Section 5 is organized as follows:

Chapter 1 - Recommendations on the Basic Approach

These are the fundamental and central recommendations of the report, which are then fleshed out by the following chapters.

Chapter 2 - Recommendations Concerning Goals, Strategy, and Activity

The recommendations in this chapter are on the vertical dimension of the framework. They are expressed as if there were a single decision-making agency with the full authority to implement its decisions, through control of policy, funding, and standard-setting, and as if it were fully staffed to perform all the services called for.

Chapter 3 - Recommendations Concerning Responsibility and Roles

Since a monocratic agency in the Canadian milieu is neither desirable nor possible, the recommendations of Chapter 3 indicate what role various Public and Private Sector organizations should play in the implementation and support of the recommendations of Chapter 2, and how these organizations could interact to fulfill the Canadian CAL strategy. The chapter recommendations therefore are on the horizontal dimension of the framework.

Chapter 4 - Recommendations Concerning Planning and Timing

Given a requirement to mobilize the organizations and agencies discussed in Chapter 3 to accomplish the recommendations of Chapter 2, this chapter contains recommendations concerning the planning and implementation of the strategy, the promotion of the concepts, and the timing of the steps required. The chapter's

THE CAL INDUSTRY PROGRESS MODEL

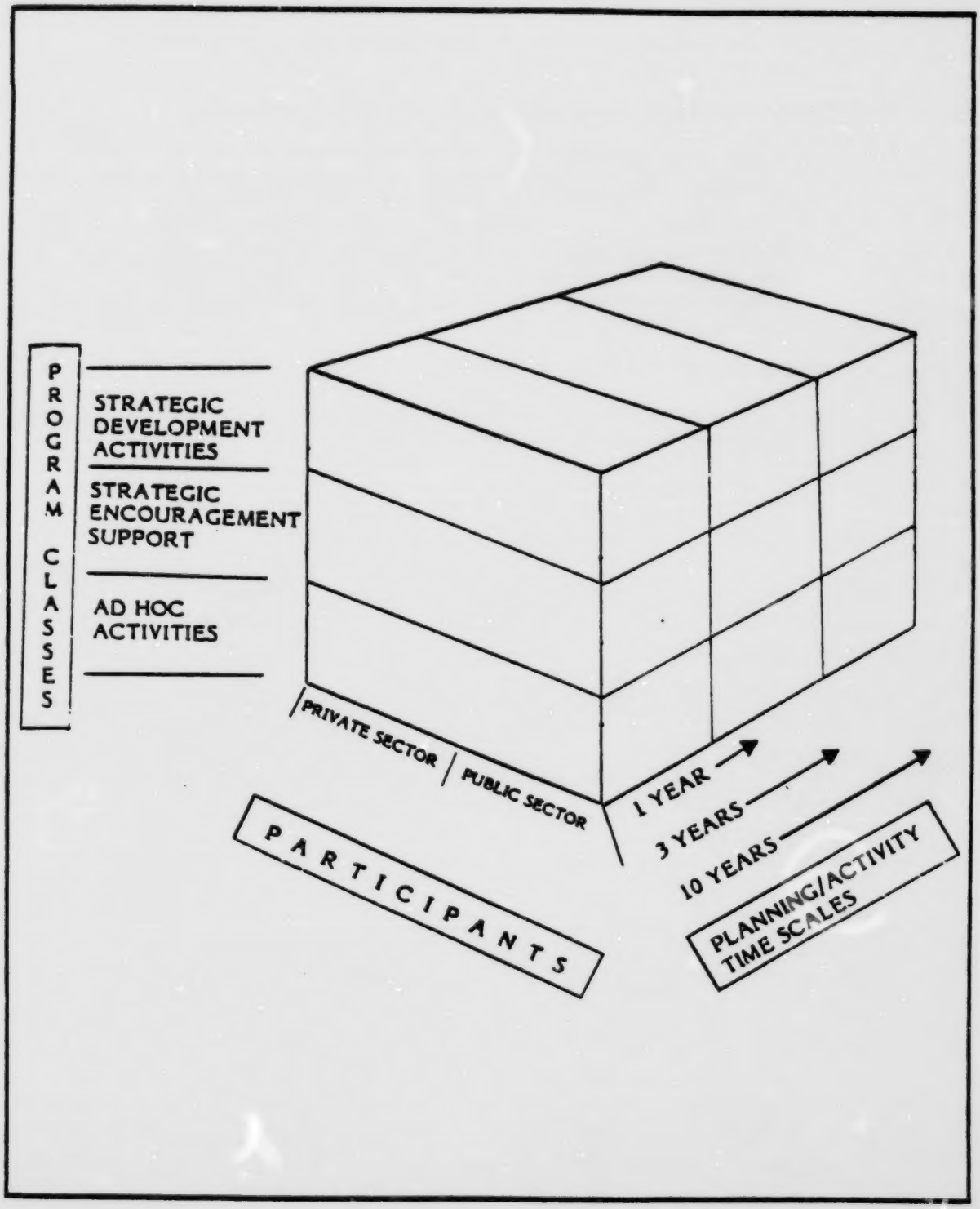


DIAGRAM 9

recommendations provide the basis for the third dimension of the framework.

Chapter 4 - Recommendations Concerning Planning and Timing

Given a requirement to mobilize the organizations and agencies discussed in Chapter 3 to accomplish the recommendations of Chapter 2, this chapter contains recommendations concerning the planning and implementation of the strategy, the promotion of the concepts, and the timing of the steps required. The chapter's recommendations provide the basis for the third dimension of the framework.

Chapter 5 - Recommendation Summary

This chapter is a two-page summary of the 34 recommendations of Chapters 1 through 4.

CHAPTER 1

RECOMMENDATIONS ON THE BASIC APPROACH

The recommendations of this chapter comprise the fundamental thrust of the report. The recommendations of the other chapters of this section provide more detail, and focus on how they are to be implemented.

Recommendation 1.1
that the goal and strategy described in Section 2 of this report be adopted as the basis for developing a plan on policy and activity concerning the Canadian CAL Industry.

Recommendation 1.2
that such a plan include specific activities to address all technological, economic, political and other issues, including those described in Sections 3 and 4 of this report, and others which will arise as implementation proceeds.

Recommendation 1.3
that such a plan identify steps required to achieve a practical level of consensus concerning the plan and its implied policies and activities amongst those organizations and individuals in the industrial, home and educational CAL Industry sectors who will participate in the implementation of the plan or will be impacted by its implementation.

Recommendation 1.4
that such a plan have built into it an appreciation that a strong consensus of all of the vendors, users, funders, and regulators of the industry in the early stages of such a strategy is highly improbable, and that existing support for activities and products in the CAL Industry, whether or not they are supportive of the recommended strategy, must continue and even be enhanced in parallel with strategic activity.

Recommendation 1.5
that such a plan include a mechanism for the periodic review and re-orientation of the goal, the strategy, the plan, and its implementation; and that such review be under the guidance of a broad national group representing those sectors of the industry that are most affected by the plan, including representation of major users of CAL systems and courseware.

CHAPTER 2

RECOMMENDATIONS CONCERNING GOALS, STRATEGY AND ACTIVITIES

The recommendations in this chapter are expressed as if there were a single decision-making agency with the full authority to implement its decisions, through control of policy, funding, and standard-setting, and as if it were fully and competently staffed to perform all the services called for.

Therefore these recommendations do not address specifically who should do what, which Government body or level should take responsibility for it, or what must be done to accomplish what is required by the recommendation. Such issues are addressed in Chapters 3 and 4 of this section.

The recommendations of this chapter are organized into several parts, as follows:

A - On the Goal
Recommendations about the adoption of a National Goal, the establishment of objectives based on that goal, and the installation of means to evaluate progress.

B - On the Strategy
Recommendations about the major elements of a strategy to achieve the National Goal.

C - On the Structuring of Expenditure
Recommendations about the allocation of funding to implement the strategy.

D - On the Structuring of Participation
Recommendations about the method by which Private and Public Sector organizations and individuals impacted by strategy decisions participate in the process that defines the nature of government support.

A - RECOMMENDATIONS ON THE GOAL

Chapter 1 of Section 2 describes a CAL Industry goal, with four specific aspirations. These are incorporated into the following recommendation:

Recommendation 2.1

that a goal be established for Canada in which the CAL Industry is:

1. a major employer of Canadians.
2. a major contributor to the Canadian balance of trade, with a positive flow of up to $15 billion by the mid-1990s.
3. a major contributor to superior Canadian education.
4. a major contributor to productivity and effectiveness in all Canadian industries.

For any strategy to be effective, it requires that a goal be translated into measurable objectives, with vehicles established for measuring progress towards those objectives. Therefore:

Recommendation 2.2

that specific and measurable objectives be established for progress evaluation in each of the four subgoals of Recommendation 2.1;

and furthermore that appropriate vehicles be established for the measurement and reporting of progress for each of these objectives, with a national agency responsible for such measurement and reporting.

B - RECOMMENDATIONS ON THE STRATEGY

In Section 2, a Canadian Courseware Registry, a coordinated marketing program, and a program for the productivity improvement of courseware production are identified as three requisites of a successful Canadian CAL Industry strategy (Section 2, Chapter 4, 5, 6), resulting in the following recommendations:

Recommendation 2.3

that a Canadian Courseware Registry be established, as described in Section 2, Chapter 4 of this report, fully supported by technical tools, administrative systems, and trained personnel;

and that the operator of such a registry provide services such as courseware classification and registration, format conversion, inventory supply and maintenance, and CAL Industry standard coordination;

and furthermore that there should be a staged implementation of the registry, based on economic, technical, and other considerations.

Recommendation 2.4

that a national-level coordinated CAL Industry Support Program be established, as described in Section 2, Chapter 5 of this report, with special emphasis on export marketing of courseware inventory and skills, distribution, user support, usage tracking, and royalty accounting;

and furthermore that there should be a staged implementation of such a program.

Recommendation 2.5

that a program to research and develop means to significantly improved productivity for courseware creation be established, through vehicles such as authoring tools, courseware development and project management methodologies, author/developer education materials, and other software and hardware tools.

and furthermore that there should be a staged implementation of this courseware development program productivity based on economic, technical, and other considerations.

The development and publication of several Canadian Courseware Registry Standards (CCRS) and the development of tools to assist the conversion of courseware to and from the Courseware Conversion Code Standard have been identified as essential elements of a solution to several obstacles to a Canadian CAL Industry (Section 2, Chapter 4), resulting in the following recommendation:

Recommendation 2.6

that Canadian Courseware Registry Standards (CCRS) be developed, which include standards for courseware description and a courseware conversion code for courseware presentation interchange as described in Section 2, Chapter 4 of this report;

and that authoring languages and methodologies referred to in Recommendation 2.5 be supported by tools which help their users comply with the standard for courseware conversion code;

and furthermore that additional utilities and services be developed which can help to convert courseware implementations to and from the conversion code standard.

In Section 2, a basic strategic model is presented (**Diagram 5**). The central elements of this model, which have been addressed by Recommendations 2.3 to 2.6 above, will require specifically initiated and directed projects to achieve reality.

On the other hand, a system of support, opportunity creation, and incentives will be required to supply the other elements of the model; that is, on the supply side for people creating software and hardware environments for courseware development and presentation, and, more important for the courseware itself, and on the demand side, for people utilizing the presentation systems and courseware. Some specific programs have been described in this area (Section 2, Chapter 5), and the following recommendation refers to such forms of support:

Recommendation 2.7

that a number of specific programs be initiated and funded to support and encourage the supply and demand side of the CAL courseware industry;

and that these programs include, to address the demand side, a CAL support centre, training programs for institutions using or considering the use of CAL, and incentives for utilizing Canadian courseware maintained in the Canadian Courseware Registry;

and that these programs include, to address the supply side, content subsidy programs, courseware author training programs, and subsidy for development of courseware productivity improving hardware and software;

and furthermore that these programs include Private Sector investment incentives through vehicles such as investment and R&D tax benefits and loan guarantees.

CANADIAN COURSEWARE REGISTRY SUPPORT SYSTEM

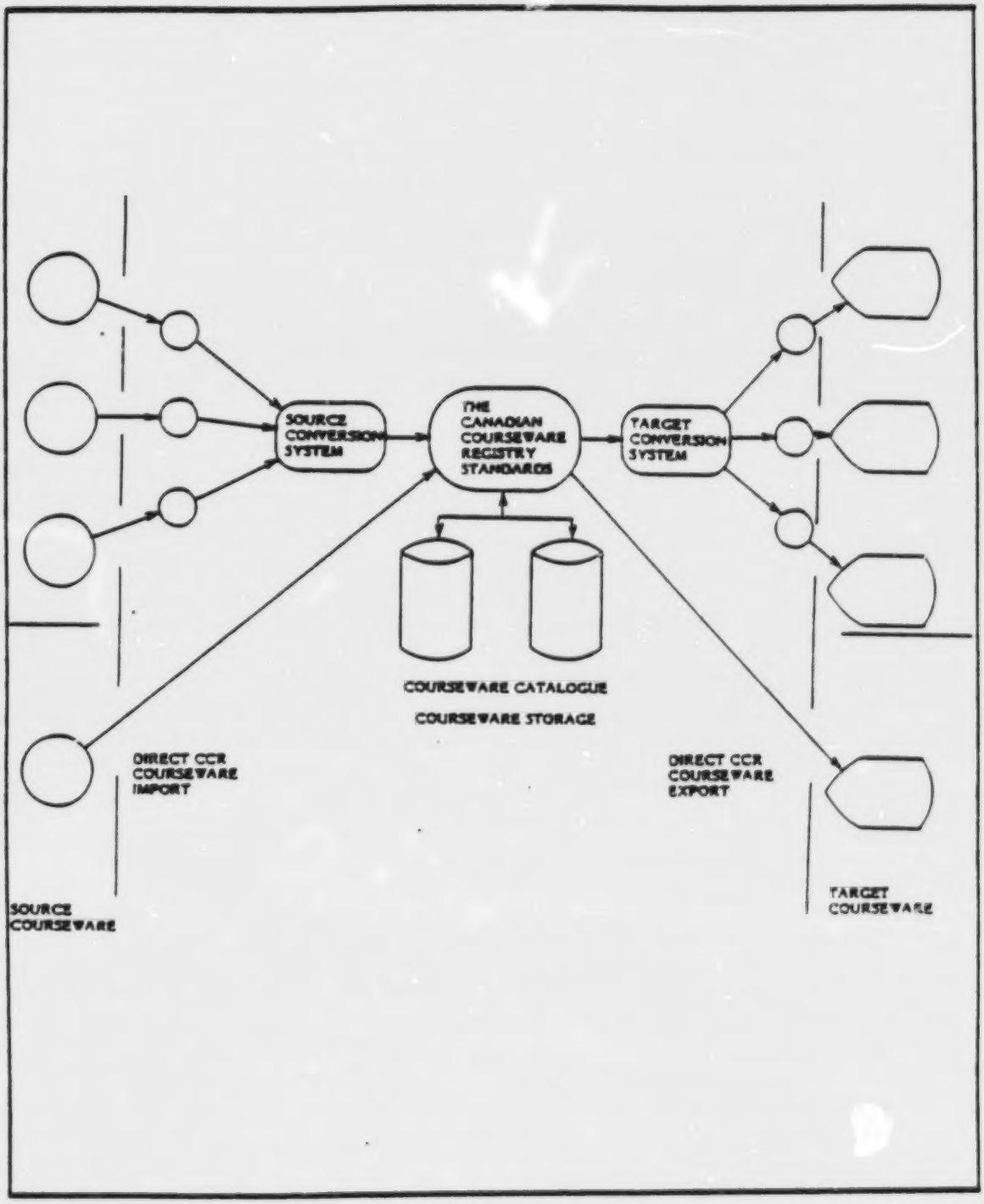


DIAGRAM 3

C - RECOMMENDATIONS ON THE STRUCTURING OF EXPENDITURE

To achieve a National goal such as described in Recommendation 2.1, some major investment of funds will have to be made by Government, besides investment within the Private Sector.

There are three types of expenditure required for a comprehensive implementation of the recommended strategy, and these are:

- Strategic Development (SD)

  Strategic Development expenditure is direct investment in those elements of the strategy, for which specific projects must be launched and centrally funded. Such activities normally take one of the following forms, or some combination:

  - projects conducted and staffed by a Government body. Examples might include research conducted by NRC, or strategic planning activity performed by the Department given responsibility for strategic planning.

  - projects directly contracted out by a Government body. Examples might include feasibility and planning studies, or the development of a royalty accounting system.

  - projects performed by a Private Sector organization in preparation for providing a "utility service", supported by Government "seed money". For example, the Canadian Courseware Registry will probably be a utility service, and the project to develop or acquire the hardware and software required for a Courseware Registry Support System might be funded by seed money.

- Strategic Encouragement (SE)

  Strategic Encouragement expenditure is funding and other forms of support provided to the Private Sector aimed at promoting specific activities and product development within the CAL Industry that have been identified in an industry development plan as strategically valuable.

  Although such projects are not specifically called for or contracted by the government, by publicizing the strategy and its requirements throughout the industry, and by having specific incentive programs for this class of activity, Private Sector initiatives can be encouraged.

Expenditures in this category can take many forms. Tax incentives (expenditure through lost tax income), free training programs for users of the registry, and specific grants for research and/or development are examples.

Examples of activities which might be supported through Strategic Encouragement funding might include supporting an authoring language manufacturer having a project to develop a utility that produces CCR compatible courseware conversion code from existing courseware developed prior to the existence of the standard. Strategic Support could also support content development if it is being created within the authoring methodology promoted for productivity improvement.

- Ad Hoc Support (AH)

Ad Hoc Support expenditure refers to funding and other forms of support for CAL Industry activities which are not directly related to the adopted strategy, or to any of the planned activities resulting from it, but which is relevant to furthering the Canadian goals. As stated in Recommendation 1.4, it is assumed that a large amount of such activity will take place throughout the industry, and must be actively supported. In fact, support of Ad Hoc activities must be looked upon as a vital ingredient of the strategy, because of its contribution towards the employment and trade goals, and, perhaps more important, because it is unforeseen and undirected activity which provides new technology, new ideas, and new insights into strategy and markets.

Examples of Ad Hoc activity might include the development of a new software/hardware package to implement a new course authoring language that is not consistent with the authoring languages being promoted for productivity improvement and that does not export courseware conversion code that meets the requirement of the Canadian Courseware Registry Standards mentioned in Recommendation 2.6.

The position of this report is that because of fragmentation of programs and responsibilities in the Public Sector, and lack of a cohesive funding and support program, all CAL-oriented activities have been underfunded in the past, considering the strategic potential of the industry, and that even those activities which will be considered to be "Ad Hoc" with respect to an established strategy must have substantially improved support. This does not imply that all proposed activities must be given automatic, knee-jerk support. The agencies responsible for applying ad hoc funding budgets will

continue to be expected to use judgment concerning the efficacy of every proposal.

These three classes of expenditure provide a very useful framework for strategic planning. On the one hand, a short-term plan can identify specific allocation to each of the three categories, criteria for evaluating activities in each, and specific programs for the support of each. On the other hand, long-term strategic plans can identify desired trends in the percentage and actual funding allocation of each of the categories, as illustrated in **Diagram 10** and **Diagram 11** (opposite the following page) (the allocations expressed in the diagram are for illustration purposes only, and not specifically recommended).

Recommendation 2.8

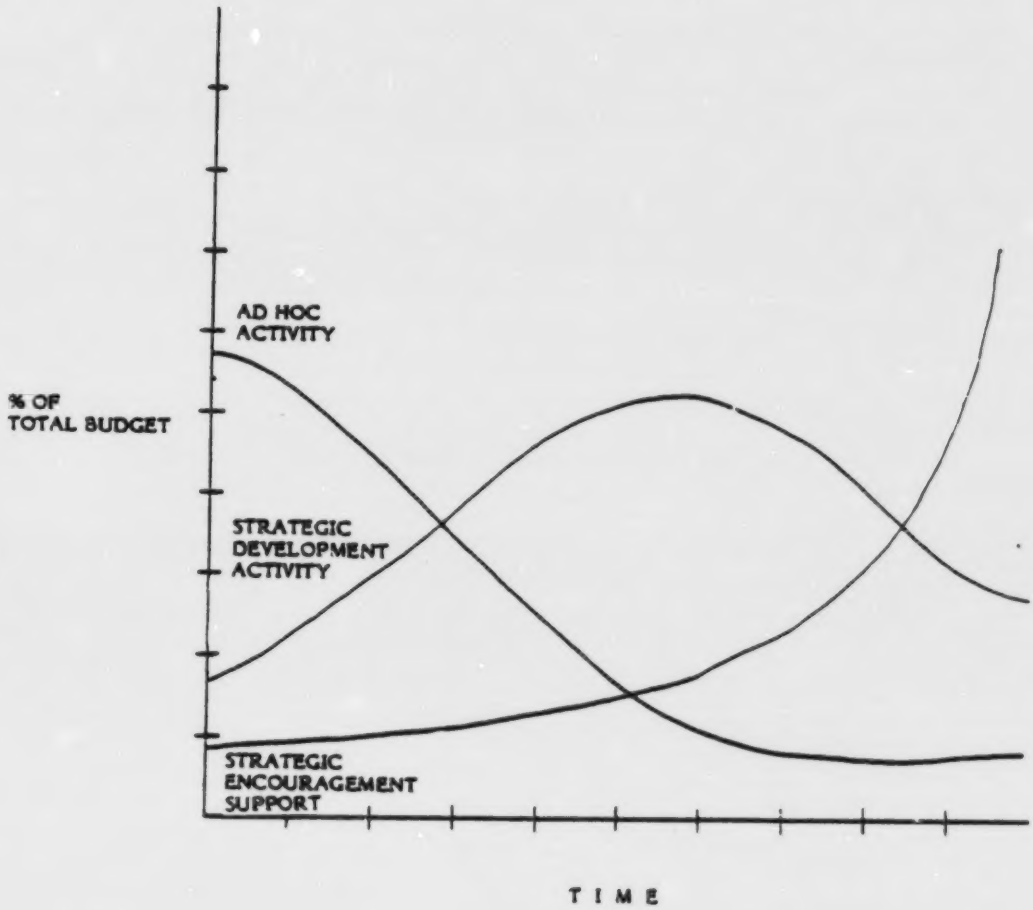
that plans be developed for implementation of the strategy described in Recommendations 2.3 to 2.7, and that these plans specifically allocate Government funding to three categories:

- Strategic Development (SD)
- Strategic Encouragement (SE)
- Ad Hoc Support (AH)

and that programs and projects be annually funded in each of these categories;

and furthermore that a long-term plan identify real and percentage allocation in each of these categories in each year of the plan.

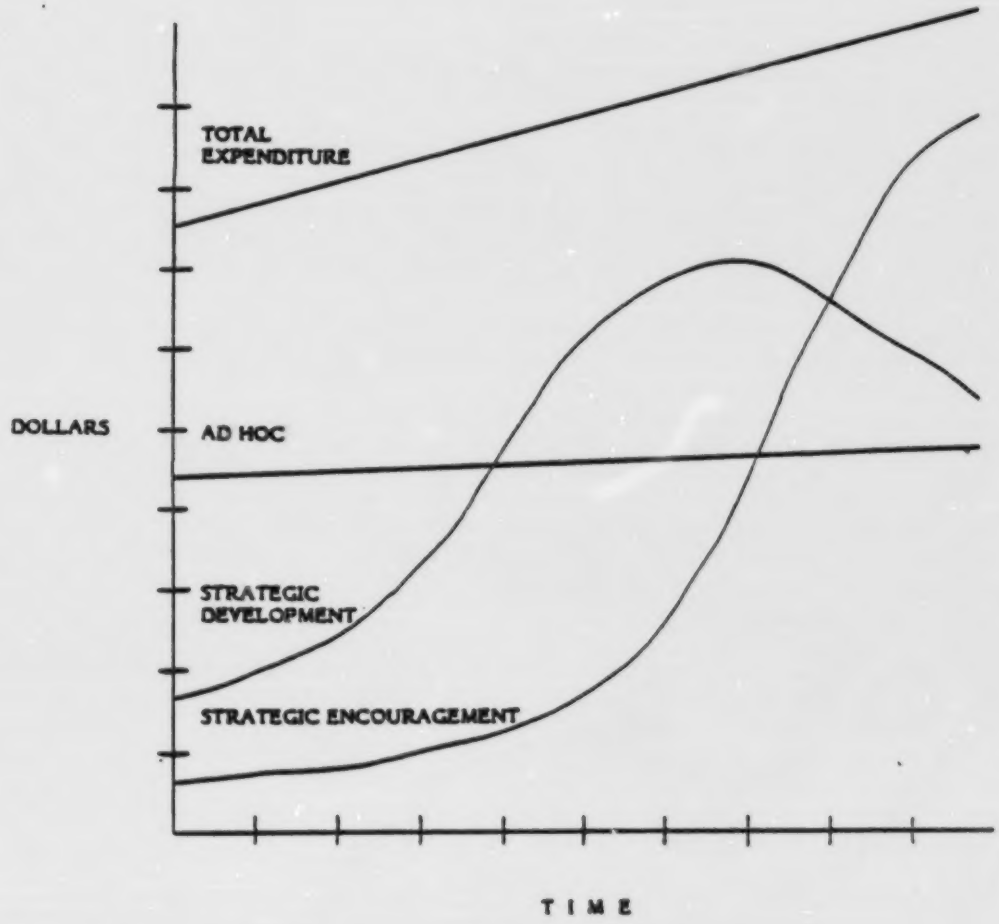
PERCENTAGE OF TOTAL FUNDS ALLOCATED TO EACH PROGRAM CLASS THROUGH TIME



(This diagram has the purpose of illustrating the concept and does not constitute recommendations of specific allocations).

DIAGRAM 10

ACTUAL FUNDS ALLOCATED TO EACH PROGRAM CLASS THROUGH TIME



(This diagram has the purpose of illustrating the concept and does not constitute recommendations of specific allocations).

DIAGRAM 11

D - RECOMMENDATIONS ON THE STRUCTURING OF PARTICIPATION

The CAL Industry is, by definition, highly complex in structure. It falls within Federal and Provincial jurisdiction. It includes, on the demand side, major industries at the Public Sector, the general public, and all levels of the educational community, while the supply side includes equipment, programming, and courseware developed by free-lancers, educational faculty, employees of companies in industry and companies manufacturing for the CAL Industry.

The structuring of participation refers to the way in which participation is classified, how industry policy decisions are formed and evaluated, how policy and programs are communicated and controlled, and how interaction is encouraged amongst participants. **Diagram 12** (opposite) outlines the recommended structuring of participation.

The first point to be noted is that a national goal and a national strategy cannot be implemented without some central focal point. Therefore, a central coordinating body must be appointed whose responsibility is to develop and publish a strategy, to coordinate planning, and to evaluate and report on the progress of the strategy.

On the other hand, considering the size and importance of the industry, no single agency should have the authority to speak for the industry, nor to plan for it. Therefore:

Recommendation 2.9

that the responsibility for developing a coherent strategy, for coordination of the planning and reviewing process, for publication of plans, policies, and guidelines, and for gathering and maintaining of records to support evaluation of progress against objectives be assigned to a single agency, referred to hereafter in these recommendations as the "CAL Industry Strategic Planning Agency";

and that a policy committee be established, referred to hereafter in these recommendations as the "CAL Industry Strategy Review Board", with adequate representation from the CAL Industry, the various levels of Government, the educational community, and established associations representing suppliers and users of CAL products;

and furthermore that this committee be charged with the responsibility of advising the CAL Strategic Planning Agency, and that it have authority to approve such plans as are produced by that agency.

CAL INDUSTRY PARTICIPATION STRUCTURE

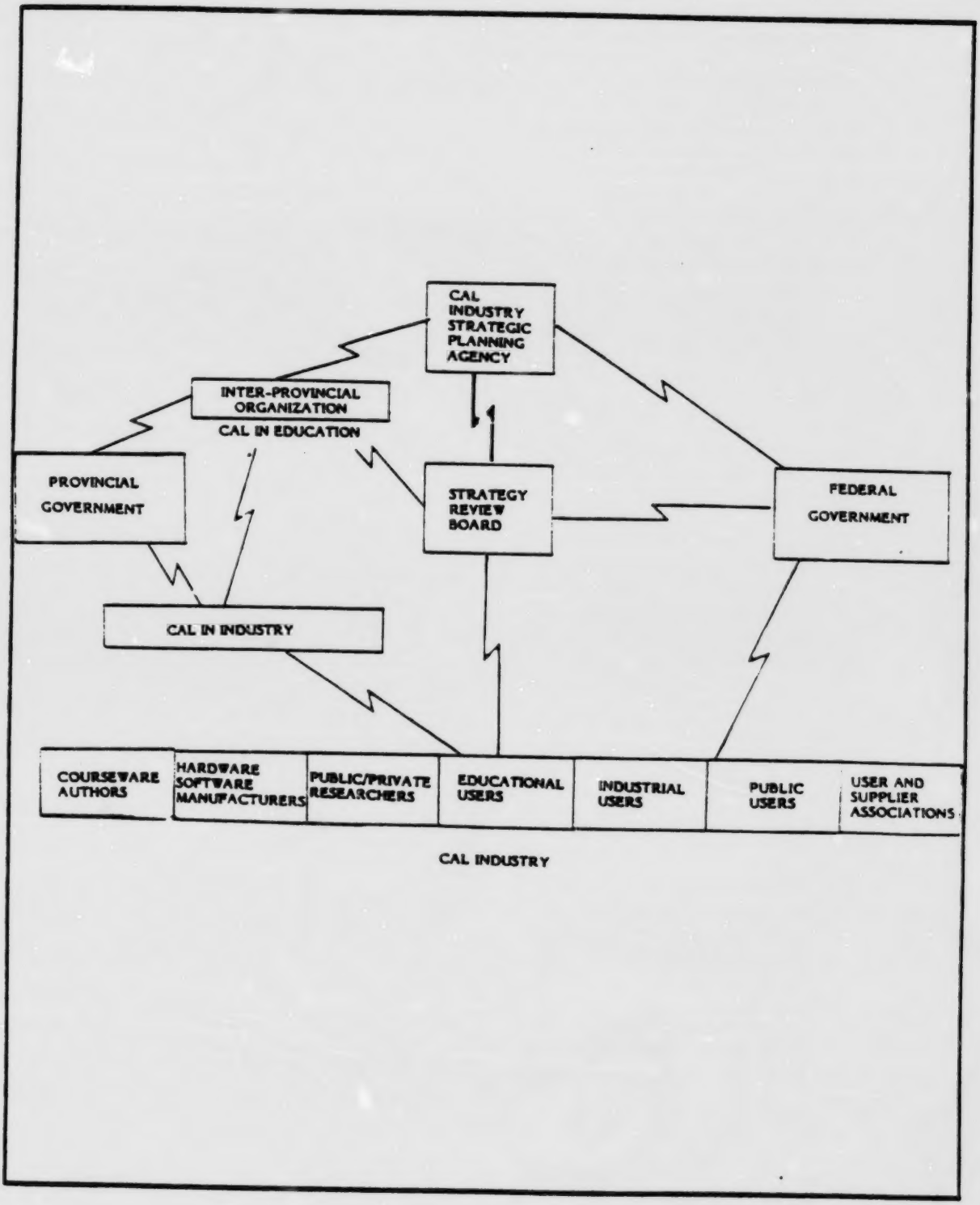


DIAGRAM 12

Educational systems are the jurisdiction of Provincial governments. While a national policy-making agency can establish standards and broad programs that impact education, they can only be implemented if approved by the Provinces. On the other hand, there is a requirement for cross-Canada activity that could be severely impacted if its implementation is not consistent throughout the Provinces. Therefore:

Recommendation 2.10

that an inter-provincial agency for CAL in education be established, representing the Ministries of Education of the Provinces, with responsibility for formulating and gaining approval of inter-provincial programs and policies that affect the field of education, and for interacting with the CAL Industry Strategic Planning Agency to ensure that the agency work is consistent with Provincial requirements.

In order for there to be adequate communication and consultation throughout the industry, some form of industry registry will be required, and some forum for interaction and for policy involvement. Therefore:

Recommendation 2.11

that a CAL Industry Participant Registry be established listing those companies, individuals, universities, and associations which comprise the Canadian CAL Industry, and that a classification method be established for structuring the registry into major CAL Industry segments;

and that steps be taken to ensure that industrial users of CAL are represented in the industry structure through the formation and/or recognition of one or more industrial user associations.

and that some organization have responsibility for maintaining the industry registry, and keeping the people and organizations of the registry aware of industry-relevant affairs;

and that an annual conference be convened, supported by Federal funding, of registered members of the Canadian CAL Industry, and that long and short-range strategies and plans be described to this conference by members of the Strategic Planning Agency and the Strategy Review Board;

and furthermore that this annual conference have the authority to confirm the Private Sector membership of the Strategy Review Board, or to elect new members from the Industrial sector.

Finally, two recommendations of this report have to do with ensuring that the industry remain largely as a Private Sector endeavour, and that Government support minimize interference with private initiative.

Recommendation 2.12

that it be standing policy of the Federal and Provincial governments, with regards to the development and implementation of a National CAL strategy, that wherever possible the implementation of that strategy should be left to the Private Sector, supported by direct incentives, by the letting of contracts, and by the creation of an investment climate that encourages Private Sector initiative.

Recommendation 2.13

that any standards applied by Federal or Provincial governments for application within the governments themselves (as users), the institutions which fall within their jurisdiction (for example, school boards), or as criteria for funding or other support (for example, courseware development support grants), be always expressed in terms of generic standards or protocols, and never in terms of specific products or suppliers.

CHAPTER 3

RECOMMENDATIONS CONCERNING RESPONSIBILITY AND ROLES

In all areas of Canadian industrial and technology policy, the following issues tend to arise:

- What should be the responsibility of the Public Sector, and what should be left to the Private Sector.

- What should be the responsibility of the Federal Government versus the Provincial Governments, and in what areas should Federal Government participation be limited to coordination services or bulk-sum financing of the Provinces.

- What should be directly funded or supported, and what should be indirectly supported through such vehicles as tax incentives, and import restrictions.

The recommendations of this chapter focus on the specific role of various public sector organizations, and, in addition, on the role of existing Canadian technology, with emphasis on Natal.

A - THE ROLE OF THE FEDERAL AND PROVINCIAL GOVERNMENTS

Generally, the Federal Government is identified in this report as the major creator and custodian of a national goal and strategy for the CAL Industry, and the prime mover in effecting the steps necessary for implementation.

Although the following recommendations attempt to define the scope of Federal responsibility, they do not specify which department should have which responsibility, something which must be established during the earliest stages of implementation. In certain areas, it would appear that the choice is obvious -- for example, National Research Council should continue to have the responsibility for performing and contracting out research and development, and for industrial research through funding programs such as IRAP and PILP. DREI seems the appropriate department for administration of support programs for supply-side initiatives. Statistics Canada could very well provide the services of measuring CAL Industry goal attainment. It is less clear as to who should administer programs supporting the demand side, and organizations such as the Department of Communications might be the logical candidate for administration of Field Trial programs, being already experienced in this form of activity.

What is clear is that:

- as discussed in Recommendation 2.9 there must be one and only one central body whose responsibility is the development of a strategy and the coordination of planning within the strategy.

- that Federal activities, no matter what departments conduct them, must be consistent with the plans developed by that agency, with whatever cross-departmental approvals that are required before those plans are finally published, and that the standards, criteria, and expenditure classification percentages must be adhered to, or success is impossible.

This suggests that there are probably two different approaches, possibly equally viable, for the structuring of Federal involvement in the CAL Industry:

1- All CAL-related activity to be performed by one Department formed for that purpose and given that responsibility.

2- One department given responsibility for the role of CAL Industry Strategic Planning Agency, but subject to comment by other departments and cabinet approval, with well-defined

roles for each of the other departments that have any role to play, and with clear-cut controls to ensure that most federal activity is according to the strategy and the plans which comprise that strategy.

Also clear is that the area of usage of CAL in education is not part of the Federal mandate, other than at the research level, and therefore funding for this and other Province-jurisdiction activity is recommended on the bulk-transfer level only.

Recommendation 3.1

that the Federal Government have responsibility for the following areas of activity, with reference to the CAL Industry:

1- Strategic planning in the areas of CAL technology development, CAL Industry development, CAL international marketing, and the use of CAL in Canadian industrial training, towards the achievement of the goals, objectives and strategy described in Recommendations 2.1 through 2.7, by establishing and staffing a CAL Industry Strategic Planning Agency, in collaboration with a CAL Industry Strategy Review Board, as described in Recommendation 2.9.

2- Development and propogation of standards in support of these strategic plans.

3- Implementation of specific Strategic Development projects, as described in Recommendation 2.8, whose goal is to support or implement the strategic plans, through some combination of Government-staffed activity and Government-specified but contracted projects.

4- Provision and supervision of funding for Private Sector initiatives, allocated proportionately according to strategic plans, to Strategic Encouragement and Ad Hoc Support, as described in Recommendation 2.8.

5- Provision and supervision of research funding to Private and Public Sector organizations and to Universities, proportionally allocated, according to the strategic plans, to the Strategic Encouragement and Ad Hoc categories.

6- Block funding to Provincial Governments for use in their jurisdictions, ear-marked for specific areas of Strategic Encouragement activities.

7- Activity as required by the strategic plans in areas of Federal Jurisdiction such as taxation policy, importation policy, and the establishment of laws and public education programs on

courseware ownership rights in fields such as courseware protection.

8- Identification of required industry measurements and establishment of vehicles for gathering and analysing statistics.

9- Strategic Encouragement through judicious use of standards within the Federal Government itself, with regards to the usage of CAL within departments, within manpower training programs, and as specifier of education and documentation standards for high technology products supported by the government.

10- Coordination and promotion of specific "field trial" and "pilot" programs, within the Federal government, and in the broader Public and Private Sectors.

11- Establishment and maintenance of a CAL Industry Participant Registry, convening of an annual industry conference, ongoing communication with the people and organizations listed in the registry, with respect to plans, policies, and industry news, and coordination of the process of nomination and confirmation of the Private and Public Sector members of the CAL Industry Strategy Review Board, all as described in Recommendation 2.11.

A key problem that remains is the issue of CAL in education. This is the domain of the Provinces, but inter-Provincial strategy does not seem to be implementable through Federal coordination of provincial planning. Thus, some form of inter-provincial planning agency is required under the control of the provinces. The Council of Ministers of Education (CMEC) appears to be the most appropriate vehicle for forming and controlling such an agency. Therefore:

Recommendation 3.2

that the "CAL in Education" agency referred to in Recommendation 2.10 should be formed under the auspices of the Council of Ministers of Education (CMEC) , be funded by the Federal government and the Provinces, and be staffed by assigned members of the Ministry of Education of the Provinces, and that the responsibilities of the CMEC with respect to CAL should be as follows:

1- Direct participation on behalf of the Provinces on the Strategic Planning Board described in Recommendation 2.9.
2- Approval of those aspects of the National CAL Strategy normally under the jurisdiction of individual Provinces that applies to the field of education.

3- Formulation, through the efforts of the CAL in Education project of an Inter-Provincial strategy for the usage of CAL in education and plans for the implementation of such a strategy throughout the country.

4- Measurement and evaluation, through the efforts of the CAL in Education project, of the effectiveness of the National Strategy and the CAL in Education strategy.

5- Ongoing liaison on the part of the CAL in Education project between the Federal agency or agencies responsible for CAL strategy and the Provincial governments, insofar as that strategy affects the jurisdiction of the Provincial Governments.

The Provincial Governments themselves each have their own jurisdiction in education, and, in addition, have their own programs to support industry in their provinces. A successful Canadian CAL Industry therefore requires cooperation at the Provincial level, in addition to the inter-provincial domain discussed above. Therefore,

Recommendation 3.3

that each Provincial Government have responsibility for the following areas of activity, with reference to the CAL Industry:

1- Participation in strategic planning relevant to the National Strategy, through liaison with the Federal Government, and representation in the Strategic Planning Board through the auspices of the CMEC.

2- Participation in the development of an Inter-Provincial Strategy for the usage of CAL in education, through specific allocation of Ministry of Education staff to the CAL Project of the CMEC, as described in Recommendation 3.2.

3- Policy and administration as regards the implementation of the National CAL Strategy, and the Inter-Provincial Strategy for the use of CAL in education, within its own jurisdiction.

4- Administration of bulk-transfer funds from the Federal Government, as described in Recommendation 3.2, according to the ear-marked proportion of Ad Hoc and Strategic Encouragement categories, and administration of such other funds as can be made available by the Province itself, apportioned according to Provincial priorities.

5- Establishment of CAL author training courses, in teacher training programs, in accordance with the Inter-Provincial Strategy, and consistent with the National CAL Strategy.

6- Establishment and support of CAL author training courses in post-secondary educational institutions, in accordance with the Inter-Provincial Strategy, and consistent with National CAL Strategy.

7- Establishment and support, in collaboration with and funded by the Federal Government, of CAL Support Centres, and such other Strategic implementation vehicles as the Federal Government is prepared to fund.

8- Strategic Encouragement through judicious use of standards within the Provincial Government itself, with regards to the usage of CAL within departments, programs and product acquisition efforts.

Certain aspects of the National strategy are not likely to be implementable through background incentive or support programs, but will require well-funded central organizations to implement. This certainly includes areas such as the operation of a Canadian Courseware Registry, International Marketing programs, and operation of a nationwide communication network for the transmission of courseware to and from the central registry. Government operation of such programs might, at first, seem appropriate. On the other hand, as laid out in Recommendation 2.12, there is a requirement to put as much as possible into the Private Sector, and therefore:

Recommendation 3.4

that the Federal Government appoint one or more Private Sector companies or consortiums of companies, to be fully supported during a pre-established program development period with seed funding, but eventually to be self-supporting, and that these organizations be given responsibility for creating and executing "utility" services identified as part of the National Strategy, and that such companies or consortiums be regulated as is necessary to ensure that their service is equitable and consistent with the National Strategy;

alternatively, that the Federal Government create a Crown Corporation, or mandate an existing Crown Corporation to perform such activities.

B - THE ROLE OF NATAL

Until recently there has not been a commercially available version of NATAL, and the educational community has tended to treat discussion of NATAL with a grain of salt, despite the fact that it has been funded, promoted, and used with strong success in several environments. During 1984, the first commercial versions of NATAL are likely to be available, one in the mainframe market, and one in the educational market.

Although NATAL will already be ten years old by the time it is "born", it should, nonetheless, prove to be the most powerful CAL system available in Canada, from the perspective of its capability of handling multiple input and display devices, multiple modes of interaction, and highly sophisticated courseware design.

Its most significant power is in its modularity, its design for portability, and its flexibility for absorbing new computer, communication, display, and courseware design technology.

The disadvantages that NATAL may face in the marketplace as an authoring and presentation system are as follows:

1- Its most important capabilities, as described above, will not be immediately significant to the largely unsophisticated CAL user community of today.

2- Although its authoring interface is at least as good as the vast majority of products on the marketplace today, it is certainly the least developed of all aspects of the original NATAL concept. Computer-wise authors will have little difficulty learning it; computer-inexperienced people will encounter some initial difficulty - there is a lot to learn, and a true beginner subset has not yet been developed. Furthermore, the two versions which will be in the marketplace require a fair degree of understanding of the computer environment to even get to the authoring system. Given the state of most other CAL systems, this should not represent a major drawback to organizations making their first entry into the field of CAL; but authors and users already using other vehicles may not be as attracted to switch allegiance as they might have been.

3- There is already an inventory of courseware in the marketplace, developed and being used in other environments. Many potential customers of NATAL as a commercial system will be faced with the prospect of running two computer systems to continue to use what they have

while also developing in the NATAL environment. This factor is particularly important in the industrial marketplace.

4- The two versions of NATAL which are now becoming available on the marketplace are severely limited by their computer requirements. The mainframe version will be expensive, and will run only in a time sharing environment, with no capability for offloaded development or presentation. This will limit its attractiveness in the industrial environment, and may cut it off completely from the educational market. The micro version runs under an operating system that may, with time, make inroads in the industrial market but has not done so to date. For this reason, it will probably have little applicability in the large industrial marketplace in its first releases. On the other hand, its hardware requirements may limit its market in the educational sector to those who can afford a reasonably expensive system.

Because NATAL may not, in its first commercial manifestations, "take the marketplace by storm", there is a danger that such "lack of success" may dampen enthusiasm for further NATAL research and development. The position of this report is that such a situation would be tragic because NATAL's design philosophy, capabilities, and portability protocols are vitally useful to any strategy for a CAL Industry such as described in this report.

In fact, the characteristics of NATAL make it not simply the best but the only candidate for adoption as the basis of the Canadian Courseware Registry Standard described in Recommendation 2.6. The development or extension of any other system to play this role will require too much time and money that can be better applied to other areas of the strategy. This implies, then, that much of the strategy described in this document must centre around NATAL, and much research and effort must be put into making the required growth to NATAL itself, and designing improved authoring facilities, new presentation options, and conversion aids between the NATAL protocols and other CAL authoring and presentation systems.

Recommendation 3.5

that support of any and all research and product development concerning NATAL be placed in the Strategic Encouragement (SE) expenditure classification, as described in Recommendation 2.8;

and that this support be extended to existing NATAL-based products in the form of support for enhancements, extensions and new operating environments, and of industrial and educational field trials.

Recommendation 3.6

that NATAL be adopted as the basis for the Canadian Courseware Registry Standard (CCRS), as referred to in Recommendation 2.6;

and that the necessary extensions and enhancements to its specification, and the development of software to implement its use as the conversion code for the Courseware Registry be funded as Strategic Development projects (SD), as described in Recommendation 2.8.

Although NATAL's use as a conversion code standard is relatively non-volatile in the face of changing technology, authoring vehicles ("languages") and presentation vehicle capabilities are highly affected by technological change. As called for in Recommendation 2.5, there is a requirement for vehicles to improve authoring productivity and creativity, and any authoring facility developed today will have to give way to new designs in the future, as technology advances.
It is probable that many authoring vehicles will eventually be able to generate CCRS-compatible code, but if NATAL is selected as the basis of that standard, then it is likely that the easiest path to authoring language improvements will be to enhance the "front end" of NATAL itself while enhancing it as the conversion code standard, so that the authoring vehicle will naturally produce NATAL code.

Recommendation 3.7

that the design and development of an enhanced authoring facility for NATAL, with particular regard to non-procedural capabilities for non-computer-trained authors, be funded as a Strategic Development (SD) project;

and that Strategic Encouragement (SE) funding be made available to encourage University and Private Sector research and development activity in this area to ensure constant advancement of authoring facilities as technology progresses.

Particularly for the industrial marketplace (see Chapter 6), the most important implementation of NATAL will be a distributed version, in which courseware can be developed on mainframes or micros and operated in either environment. In fact, the ideal industrial version would have three portable levels, roughly mapping to mainframe, mini, and micro, with some of the software running at all three levels.

In the industrial marketplace particular attention must be paid to several aspects of any CAL system, particularly:

- The selection of operating systems on which authoring and presentation will occur.

- The design of the authoring and presentation vehicles to promote modular accessibility of the courseware, so that small segments of courseware can be accessed from other computer applications, or specifically requested at "need to know" time.

- The modular maintainability of the courseware, so that highly change-volatile aspects of training or technical courseware can be altered easily.

Recommendation 3.8

that the design and development of a distributed version of NATAL, particularly focussed on industrial usage be funded, either as a Strategic Development (SD) project, or, in collaboration with a selected vendor, through Strategic Encouragement (SE) funding.

There are many lessons to learn from the experience of Telidon: one is that total transfer without protection to the public domain is a certain way to lose the national competitive advantage offered by the technology in the first place.

Recommendation 3.9

that only the Canadian Courseware Registry Standard specification derived from NATAL be placed into the public domain, and that all other aspects of NATAL research and development be adequately protected;

and that all aspects of NATAL that have been developed under Strategic Development funding, and therefore the property of Government, be available to Canadian enterprises only through special licensing arrangements;

In order to establish NATAL as a basis for a Canadian Courseware Registry Standard, some help will be required for vendors and users of currently popular CAL systems, in both the educational and industrial environments. In the case of each CAL system, there are two levels of interface support which can be considered:

A- Language interface, so that courses written in future in that authoring language can be exported in CCRS-compatible form.

B- Courseware interface, so that courses already written in that authoring language can be imported from CCRS-compatible form.

The first, relatively speaking, is simple. The latter is more difficult, and it is assumed that the conversion will have to be more in the

form of a computer-aided labour-intensive service, than that of a software package which can accept courseware as input and produce CCRS-compatible output.

It is probable that the implementation approach, and the degree of automation of conversion for Level B will vary from authoring language to authoring language.

The strategy can be most effectively implemented if certain key systems are interfaced early, particularly for Level A, by collaboration with vendors. Three obvious candidates for this activity are CAN, Tutor (the Plato authoring language), and IIS. Tutor and IIS are strong candidates for the industrial market and CAN is important for the educational field.

Once some major systems have been interfaced for Level A, it is to be hoped that other vendors will, on their own initiative, create interfaces as well, with such efforts supported by SE funding. In addition, tools and services for Level B conversion should emerge, also supported by SE funding from CAL system vendors and independent software or courseware developers.

Recommendation 3.10

that several vendors of popular authoring systems be encouraged, through Strategic Encouragement or Strategic Development funding, to develop interface capabilities between their authoring vehicle and the Canadian Courseware Registry Standard;

and that any or all efforts within the industry to create interface tools or services at language or courseware level be funded through Strategic Encouragement allocation.

Once courseware can be "stored" in CCRS-NATAL form, the next issue becomes the ability to run such courseware in a variety of operating environments. Particularly in the industrial marketplace, there are minor variations in configurations of equipment by the same vendor, often variations even within the same operating system. Therefore:

Recommendation 3.11

that several operating environments be identified as strategic targets, and that all work done in the industry towards the development of courseware presentation and management systems that can present courses converted from CCRS format be supported with Strategic Encouragement funds.

C - THE ROLE OF OTHER CANADIAN TECHNOLOGY

TELIDON

The relationship of Telidon and CAL is natural and obvious. Telidon should be treated as an integral aspect of the CAL strategy, and the Telidon protocol should be an aspect of the CCRS. Material developed using Telidon should be stored in that format; and conversion aids should be created for converting other standard courseware for presentation in a Telidon environment.

Recommendation 3.12

that Telidon be adopted as a key aspect of the Canadian CAL strategy, and as an option within the Canadian Courseware Registry Standard;

and that tools for Telidon graphics creation, and for conversion to Telidon presentation environments be supported by Strategic Encouragement funds;

and that CAL training curricula developed as implementation to Recommendation 2.5 include teaching skills in the area of Telidon.

CAN

There is already a wide following for CAN-8; there is a considerable amount of courseware already written for it; and there is strong technical support being provided for it. Whatever its weakness in flexibility and capability, the fact remains that a large number of users will attest to its usability and learnability.

CAN must therefore be supported, not merely as an Ad Hoc aspect of the industry, but from a strategic point of view. This implies that some of the earliest efforts must be put towards making the language convertible to NATAL, and, therefore, to the CCRS; in fact, efforts at supporting Level B conversion (see Recommendation 3.10 above) should be very valuable.

There is a body of expertise in other areas as well, such as LOGO, BASIC, etc., and the recommendation which follows does not imply that we should not build on this expertise through appropriate ad hoc funding.

Recommendation 3.13

that CAN be specifically supported as an authoring and a presentation vehicle, and that the development of a language interface and a presentation interface be initiated as a Strategic Development project;

and that the development of conversion tools and services for existing CAN courseware be funded through Strategic Encouragement allocation;

and that content development in CAN be supported through some combination of Ad Hoc and Strategic Encouragement funding.

PROVINCIAL TECHNOLOGY VEHICLES

The Province of Ontario provides an excellent example of initiatives in the absence of a federal strategy in meeting the need for computers in education, in the Canadian Educational Microcomputer (CEM) project, and in its allocation of BILD funds to computer learning. By the time that a National Strategy has emerged, most other Provinces will have some stake in the ground, in the form of technology investment or establishment of standards.

No National Strategy can succeed that attempts to nullify such efforts. Therefore:

Recommendation 3.14

that all CAL-related activity in Canada be supported through Ad Hoc Support funding, directly and/or through bulk-sum transfer to Provinces;

and that wherever possible technology and standards derived from Provincial Government initiatives be incorporated into the National Strategy;

and that all efforts to transfer Provincially initiated technology, courseware, or skills to the other Provinces of Canada be supported by Strategic Encouragement funding;

and furthermore that all efforts to make Provincially initiated hardware, software, or courseware compatible with the National CAL strategy and the Canadian Courseware Registry Standards, or to make courseware available through the Registry, be supported with Strategic Encouragement funding.

CHAPTER 4

RECOMMENDATIONS CONCERNING PLANNING AND TIMING

To accomplish goals and strategies of the magnitude described in this report will require intensive initial and periodic planning efforts. As stated in Recommendation 2.9, such planning will have to be assigned to a specific agency within some area of the Federal Government.

Eventually, there should be three ranges of plans to support the goals and strategies, as follows:

Long-range plan - 10 years

The long-range plan should be 10 years out, and should be a rolling plan --that is, after each year of the plan is completed, it should be extended another year, so that it always looks out 10 years. The long-range plan should be in terms of industry goals and objectives, assignment of roles and responsibilities, planning of percentage expenditures in each of the three activity categories discussed above, and the broad plan for the implementation of specific programs over time.

Mid-range plan - 3 years

The mid-range plan should be 3 years out, and should be fixed in duration --that is, after the first year of a 3-year fixed plan, 2 years remain in the plan. Each mid-range plan should specifically allocate funds and effort to the three categories of activity, and should specifically identify what aspects of the strategy are to be implemented during that period. Thus, each 3-year plan identifies specific programs to be launched under Strategic Development activity, and plans the projects and funding to implement them. In addition, specific industry activities are identified which are considered strategically desirable, to be encouraged through Strategic Support funding.

Short-range plan - 1 year

The short-range plan includes specific budgets, programs, and activity plans within each of the three activity categories, specific schedules, review points, authorization cycles, etc.

Recommendation 4.1

that, as an initial step in the implementation of this report, a CAL Industry Strategic Planning Agency be named, and that this agency be given the mandate to produce, within one year of its formation, a plan for National CAL Strategy;

and that the plan include allocation of responsibilities and formation of roles, as described in Recommendations 3.1 to 3.4;

and that this plan consist of a 10-year, a 3-year, and a 1-year component;

and that the 10-year component include specific objectives with recommended year-by-year sub-objectives, and recommendations for annual allocation of funding, based on the framework described in Recommendation 2.8;

and that the 3-year component include the identification of specific Strategic Development projects, and how they are to be launched, the steps to be taken to ensure technical and economic feasibility of each such activity, and the deliverables and review criteria for each milestone of these projects;

and that the 1-year component include the identification of specific criteria for activities that will be supported through Strategic Encouragement funding, specific vehicles for Ad Hoc and Strategic Encouragement activity evaluation and funding, and specific plans for industry liaison and communication;

and furthermore that a pro-tem CAL Industry Strategy Review Board be formed to work with the planning agency according to Recommendation 2.9, until such time as its Private Sector composition can be approved by a meeting of registered members of the CAL Industry, as described in Recommendation 2.11.

and that the period that begins with the mandating of such a planning agency until such time as the 3-level plan has been reviewed and put into effect be referred to as Stage I of the National Strategy, and that the first three-year period under the new plan be referred to as Stage II, and that the period thereafter be referred to as Stage III.

The planning process described above in Recommendation 4.1 should certainly not be the only activity of Stage I. The following recommendation addresses other stage I content:

Recommendation 4.2

that during the period designated as Stage I, in addition to the activities required, as described in Recommendation 4.1, for the development and approval of a strategic plan, some or all of the following activities also take place:

- The allocation of funds for Stage I, divided into the three categories described in Recommendation 2.8.

- The launching of a number of "strategic development" projects to be performed during Stage I, including:
  - Further technical and business feasibility analysis of the goal and strategies recommended in this report.

  - Specification of the Canadian Courseware Registry Standards.

  - Design of an enhanced authoring facility for NATAL.

  - Feasibility study and planning, in conjunction with vendors, of language interface conversion tools, as described in Recommendation 3.10.

  - Feasibility study and specification of a distributed version of NATAL, as described in Recommendation 3.8.

  - Implementation of a manual-only Canadian Courseware Registry, through direct survey and through collaboration with existing registries and association.

  - launching of a Canadian CAL Industry survey, including the design of a classification scheme and the application of the scheme to the list of industry participants gathered in the survey, preparatory to the implementation of Recommendation 2.11.

- The identification of a number of areas of activity to be supported during Stage I on a strategic encouragement basis, including, as a minimum:

  - Any Private Sector activity relevant to NATAL, including the development of NATAL authoring skills.

  - Any Private Sector activity relevant to the identification of a National Strategy or in response to any strategic position papers released by the Planning Agency.

  - Any Private Sector activity relevant to the Canadian Registry, or contributing to the environment required to support a Canadian Registry, or toward developing the initial version of the registry.

  - Any research specifically contributing to technical feasibility analysis or solution of technical problems related to the recommended strategy.

- Comprehensive support through increased Ad Hoc funding of all CAL-related activities not included above, with special emphasis on courseware.

- Negotiations concerning the launching and funding of Private Sector or Crown Corporation companies to perform "utility" activities, as identified in Recommendation 3.4.

- Investigations concerning the market potential for export, based on a plan of country-to-country marketing.

- Investigations concerning requirements for creation of an ideal investment climate for CAL.

CHAPTER 5

RECOMMENDATION SUMMARY

1 - RECOMMENDATIONS ON THE BASIC APPROACH

1.1 Adopt goal and Strategy of Section 2 as basis for a plan
1.2 Plan should address technological, economic, political feasibilities issues
1.3 Plan should address problem of achieving a practical consensus
1.4 Plan should have built-in element to support non-strategic activity
1.5 Plan should have mechanism for review, under guidance of review group.

2 - RECOMMENDATIONS CONCERNING GOALS, STRATEGY AND ACTIVITIES

A - THE GOAL

2.1 Goal should be established as per Section 2
2.2 Objectives and measurement vehicles against goal should be established

B - THE STRATEGY

2.3 Courseware Registry, supported by standards
2.4 National and International marketing program
2.5 Methodologies, tools, and education for courseware development productivity improvements
2.6 Canadian Courseware Registry Standards (CCRS) and compliance vehicles
2.7 Incentives and support to encourage supply and demand sides of market

C - THE STRUCTURING OF EXPENDITURE

2.8 SD, SE, and AH allocations

D - THE STRUCTURING OF PARTICIPATION

2.9 Strategic Planning Agency and Strategy Review Board
2.10 Inter-provincial agency
2.11 Industry registry, annual conference, representation on Review Board
2.12 Private Sector wherever possible
2.13 Protocol and other standards, not specified products and vendors

3 - RECOMMENDATIONS CONCERNING RESPONSIBILITIES AND ROLES

A - THE ROLE OF THE FEDERAL AND PROVINCIAL GOVERNMENTS

3.1 Federal Government responsibilities
3.2 Council of Ministers of Education (CMEC) responsibilities
3.3 Provincial Government responsibilities
3.4 Regulated companies or Crown corporations responsibilities

B - THE ROLE OF NATAL

3.5 All NATAL support is SE
3.6 NATAL as basis of CCRS
3.7 Enhanced authoring facility is SD and University and Private Sector research is SE
3.8 Distributed version for industry is SE with selected collaborator
3.9 Only CCRS standards in public domain, NATAL to be protected
3.10 Level 1 interface with selected systems is SE or SD
3.11 Select strategic operating environments to be supported with SE

C - THE ROLE OF OTHER INDUSTRY TECHNOLOGY

3.12 Telidon
3.13 CAN
3.14 Provincial vehicles such as CEM.

4 - RECOMMENDATIONS CONCERNING PLANNING AND TIMING

4.1 Three-phase plan to be developed
4.2 Stage I activities

SECTION 6 - CAL IN INDUSTRIAL TRAINING

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CHAPTER 1

THE IMPORTANCE OF THE INDUSTRIAL TRAINING SECTOR

Three market sectors have been identified to which computer-assisted learning (CAL) can be applied. Each of these sectors has its own instructional philosophy, economics, and requirements for successful CAL application. They are, in summary:

- The Educational Sector, referring to the system of educational institutions that includes schools, colleges, and universities.

- The Consumer Sector, referring to direct consumer purchases of educational materials mostly for use at home.

- The Industrial Training Sector, referring to the field of providing adults with job-related skills and knowledge, usually funded by corporations in industry or by Government institutions such as Canada Employment and Immigration and the Canadian Armed Forces.

Although the vast majority of literature, statistics, and policy focus, tend to centre around the Educational Sector, the Industrial Training Sector is critical to any Canadian CAL strategy for the following reasons:

1 - It represents a major area of Canadian expenditure, estimated to be currently greater than $4 billion annually, and expected to grow at a greater rate than the Educational sector.

2 - It is the major sector within which sub-goal #4 of the Canadian goal for CAL laid out in Recommendation 2.1 can be satisfied ("a major contributor to productivity and effectiveness in all Canadian industries".) and it applies to some extent to each of the other sub-goals.

3 - Of the three sectors, it probably has the highest degree of automatibility through CAL, because of the characteristics of the sector, the relative ease with which it can be introduced, and because it is least affected by some of the constraints of CAL technology.

Some additional explanation of these parts can be found in Chapter 7 of this section -"Detail Notes".

CHAPTER 2

CAL IN THE INDUSTRIAL TRAINING SECTOR - A FRAMEWORK

The Industrial Training Sector is very broad in scope, and requires some form of framework in order to support further analysis. The framework used in the balance of this section summarized in **Diagram 13** is based on the following parameters:

A - Content classification
B - User classification
C - Audience scope

A - CONTENT CLASSIFICATION

This refers to the various education/training applications of CAL in industry. They are divided into three "education" and three "training" classifications.

Although the term "training" is often applied to all industry sponsored teaching activity, for the purposes of this framework "training" refers to learning of specific skills related to a particular job, product, procedure, or working environment, while "education" is more general in nature, providing knowledge and perspective as opposed to specific skill, and generally more applicable to high-level jobs than lower-level jobs.

Contrary to the impression that many people have concerning industry practice much of the expenditure tends to be towards upgrade or update education, with a focus on improving overall effectiveness particularly of the knowledge worker.

INDUSTRIAL TRAINING SECTOR CAL FRAMEWORK

A - CONTENT CLASSIFICATION

A1 - Career/professional	education
A2 - Update	education
A3 - Job-related	education
A4 - Job-specific	training
A5 - Product-specific	training
A6 - Environment-specific	training

B - USER CLASSIFICATION

B1 - Private Sector	Corporate Users
B2 - Private Sector	Industry Schools/Training Services
B3 - Private Sector	Product Developers
B4 - Public Sector	Internal Users
B5 - Public Sector	Manpower Trainers

C - AUDIENCE SCOPE

H/H	High Inter-corporate	High Intra-corporate
H/L	High Inter-corporate	Low Intra-corporate
M/H	Med. Inter-corporate	High Intra-corporate
M/L	Med. Inter-corporate	Low Intra-corporate
L/H	Low Inter-corporate	High Intra-corporate
L/L	Low Inter-corporate	Low Intra-corporate

Examples

A L/H course is one which can be used by very few companies (as few as one only) but applies to many people within the organization. A M/L course is one which can be used by a fair number of organizations, but applies to very few people within each of those organizations.

DIAGRAM 13

Education Classifications

A1 - Career or Professional Education
This type of industrial education provides background knowledge that enhances the general effectiveness of individuals working in a particular field or profession.

Although the content is often the same as might be encountered in college or university, the education is often offered in industry as reinforcement , or because individuals did not have an opportunity to take these courses previously.

Examples might include business practices for computer programmers, marketing skills for engineers, and general psychology courses for salespeople.

A2 - Update education
This type of education is normally designed to keep people aware of new developments and techniques in their general or specialized areas. Examples might include new developments in computer law for corporate lawyers, new theories of motivation for managers, and a survey of technological trends for computer professionals.

A3 - Job-related education
This type of education provides background knowledge and general skills required to perform a job at a particular level. Although the education is not job-specific, it is deemed important for the effectiveness of people doing that job. Examples might include time management skills for an individual promoted to a second-line management job, or basic communication skills for a worker becoming a foreman for the first time.

Training Classification

A4 - Job-specific training
This training provides the skills needed to perform a specific job at a specific level, for example a senior computer operator or a junior bank teller.

A5 - Product-specific training
This training teaches people to apply their job skills using a particular product that the company has purchased. Examples include teaching a bank teller to use a particular teller terminal, or a machine operator to use a particular lathe, or a clerk to use a new copier.

A6 - Environment-specific training
This training teaches people to do their jobs within a particular working environment, based on the particular business practices and procedures of the employer, or the particular product being produced, or the configuration of equipment with which an individual will have to work.

Examples include training an electrical salesman on a new product line, a bank teller concerning authorization procedures within a new branch, and a computer programmer to work within the project management methodology of that company.

B - USER CLASSIFICATION

This parameter refers to the Private or Public Sector organizations that may use CAL in the Industrial Training Sector.

Private Sector Classifications

B1 - Corporate Users
Companies in industry that utilize CAL directly to train their own personnel for a variety of purposes. These organizations tend to view training productivity as their major objective in using CAL in order to reduce the amount of time that students are off the job learning, and, as well, to reduce the total time for people to become productive using a new method, tool, or concept.

B2 - Industry Schools and Training Services
Companies or organizations that run training for specific industries, either as private profit-seeking enterprises or as non-profit industry association services. These organizations tend to view development and teaching cost reduction as their major objectives, and tend to focus on training which will apply to as large a base of students as possible.

B3 - Product Developers
Companies that develop or manufacture products and produce CAL materials to train the users of those products. Because such companies cannot today count on their customers having a particular computer environment, and because they cannot impose upon their customers the added cost of computer equipment purchase, this group currently is limited to companies producing computer-based products (software or hardware), with the education materials running in conjunction with their products.

Public Sector Classifications

B4 - Internal Public Sector users
Government organizations that utilize CAL directly to train their own personnel for a variety of purposes. Like Private Sector CAL users, these organizations tend to view training productivity as their major objective. As a general rule, Internal Public Sector users differ from industry users in that their training constituency is predominantly white collar.

B5 - Manpower trainers
Government organizations with responsibility for providing people with job skills suitable for finding employment in particular industries, such as employment and immigration ministries, military establishments (who train for internal and future purposes), and prisons. Like Private Sector industry schools, manpower trainers tend to view development and teaching cost reduction as their major objectives, and tend to focus on training that will apply to as large a base of students as possible.

C - AUDIENCE SCOPE

The issue of audience scope is crucial to CAL economics for the Industrial Training Sector. It refers to the question as to how many people a particular piece of training might apply to. It is possible to rate any course or subject area on a High-Medium-Low (H-M-L) basis across two facets, as illustrated in **Diagram 14.**

Inter-corporate Scope
This refers to how wide a variety of companies could use a particular course with little or no customization.

A rating of "H" might be assigned to a course on communication skills, because it applies to many corporations across many industries. Most courses in classification A1 and A2 fit into this scope category.

A rating of "M" might be assigned to a course on insurance underwriting or one on hospital administration techniques, because each applies to only one industry, but to all organizations within that industry. Courses in classification A3 and A4 often fit into this rating category.

A rating of "L" might be assigned to a course on claims handling procedures for a particular company because it is not likely to be useful outside of that company. Courses in classification A6 and some in A5 might fall into this rating category.

Intra-corporate Scope

This refers to how many employees within any one organization the course is likely to apply to.

A rating of "H" might be assigned to courses for salesmen in marketing companies, tellers in banks and trust companies, clerical procedures in an insurance company, and Corporate orientation in any large company.

A rating of "L" might be applied to a course on accounts receivable collection techniques (other than for a collection agency), operation research methods, or information resource management. Although each of these might have a high inter-corporate scope, they will normally apply to a very small number of people within any one company.

The audience scope parameter may be treated as a grid, with courses rated according to both facets. Thus, a course on accounts receivable collection techniques might be rated H/L while a course on clerical procedures for a particular insurance company might rate a L/H.

AUDIENCE SCOPE

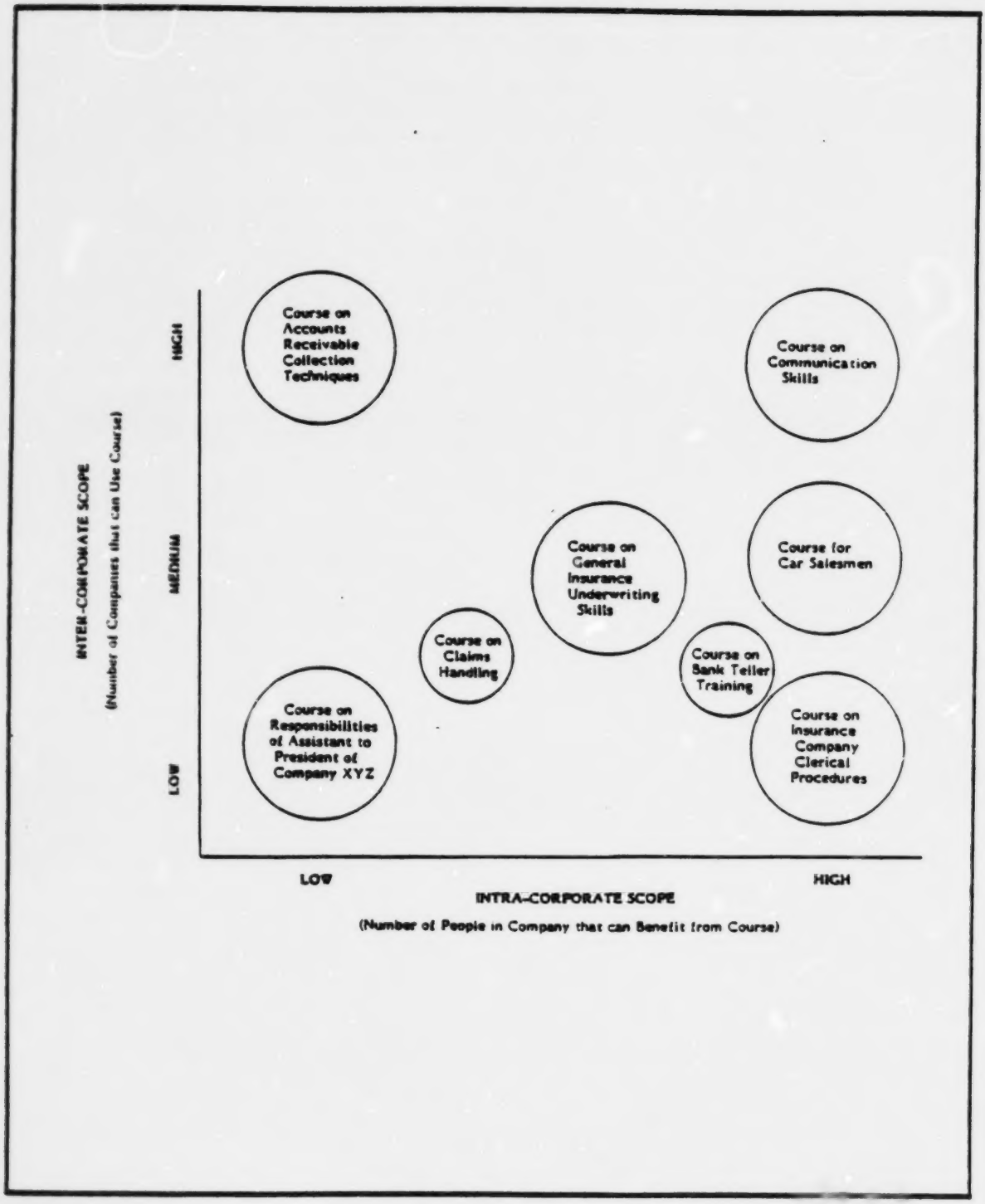
Course on Accounts Receivable Collection Techniques
Course on Communication Skills
Course on General Insurance Underwriting Skills
Course for Car Salesmen
Course on Claims Handling
Course on Bank Teller Training
Course on Responsibilities of Assistant to President of Company XYZ
Course on Insurance Company Clerical Procedures
HIGH
MEDIUM
LOW
INTER-CORPORATE SCOPE
(Number of Companies that can Use Course)
LOW
HIGH
INTRA-CORPORATE SCOPE
(Number of People in Company that can Benefit from Course)

DIAGRAM 14

CHAPTER 3

ECONOMICS OF THE INDUSTRIAL CAL MARKETPLACE

There are many factors which differentiate the industrial training marketplace for CAL from the educational marketplace. Some of these characteristics, listed below, are of key significance when formulating a plan for a CAL strategy as it applies to the Industrial CAL Sector.

Off-job time as a dominant economic factor

In the Industrial Training Sector, the dominant cost factor is the amount of time lost from work by students. Calculated on the basis of salary paid for time off the job, this factor is estimated to be roughly 50% of the cost of training in all user classifications, even including classification B5 (public sector manpower trainers).

This means that reduction of time off the job is equated with training efficiency and CAL has a clear advantage over other modes of training when it reduces the time required for learning, the need for travel, and waiting time to get access to a course.

High customizing requirement

In the Educational Sector, subject content tends to not require customization (e.g. a mathematics or history module does not lose its accuracy as it is applied across institutions or age levels); in fact most of the customization required for reuse of well-developed highly modular materials has to do with presentation style and learning level rather than subject matter. The vast majority of good Educational Sector materials, if available through a registry, would be applicable to a wide audience across many institutions throughout Canada.

In the Industrial Training Sector there tends to be a schism between education (A1 - A3) and training (A4 - A6) classifications, in that the education classifications can normally be applied across companies and industries without modification (H/H, H/L) while the training subjects tend to be highly limited in one or other of the parameters of audience scope (M/L, L/H, L/L).

The hidden educators

The majority of people developing courseware for the Educational Sector are directly employed in the education industry (e.g. teachers) or employed by vendors who

themselves are counted as part of the education industry.

Because of the customization requirement, much of the courseware required in the Industrial Training Sector requires in-house or contract development. Furthermore, the authors of CAL courseware that are employed in companies within industry are normally counted as members of the industry within which their company participates, rather than as members of the education/training industry.

This implies that estimates of the number of people employed in the CAL industry must be adjusted to account for in-house trainers authoring in CAL within other industries, and steps are required to gather information about these people for industry planning purposes.

Relative price insensitivity

Because the Educational Sector does not deal with issues such as reduction of time-off-job, increase of worker productivity, and bottom-line impact of improved managerial effectiveness, it cannot easily justify CAL through benefit analysis. Limited by education budgets, it tends to be very price-sensitive to all aspects of CAL, including equipment, software, and courseware.

The Industrial Training Sector is normally much less price-sensitive when education or training is justified through expected benefit.

Thus, in the area of micro-computers, large industry users tend to buy micros in the $5,000 to $10,000 range while education institutions tend to seek equipment in the $200 - $2,500 range. This is not necessarily because industrial users need more elaborate equipment than educational users, but because of the justification processes, and the availability of funds for justified expenditure.

Multiple-use computers

Computers have been in use in industry for about 30 years, and the typical industrial organization has many applications to run in the existing computer environment.

This environment may be mainframe-and-terminals based or micro-based or some combination of the two. Over the next two decades, most large corporations will reach a point where all white-collar workers have terminals or micros at their desks. This is a trend already visible to most corporate purchasers of computerized material, including CAL.
Since nobody wants to have, eventually, two terminals or

PRIORITY DIFFERENCES IN INDUSTRY AND SCHOOLS

	Industry	School
Development/acquisition cost	L	H
Development/acquisition lead time	H	M
Instructor cost	M	H
Student time cost	H	N/A
Computer cost	L	H
Education efficiency (time to achieve goals)	H	M
Curriculum integration	L	H
Student/teacher ratio	H	M
Pedagogic quality	M	H

DIAGRAM 15

micros on every desk, this means that a key criterion for the purchase of CAL is whether it will run in the current or planned overall computing environment, on the same equipment and operating systems, as integrated as possible with the other applications.

Even when a piece of equipment is purchased for a particular employee for the first time because of a CAL requirement, the criterion will be whether that equipment can be used for other corporate purposes as well, and whether it can interact with other workstations in the corporate network.

These factors are not particularly important in the Educational Sector or in the industry school (B2) or manpower training classifications (B5) of the Industrial Training Sector. They are mandatory to all other user classifications.

Priority differences between the Educational and Industrial Training Sectors

The table shown in **Diagram 15** is meant to be roughly indicative of the differences between priorities (on a High-Medium-Low basis) in making CAL-related decisions for schools as opposed to for industrial training purposes. Various people might classify the priorities for schools usage differently, particularly based on the type and level of school.

CHAPTER 4

KEY CAL OPPORTUNITIES IN THE INDUSTRIAL TRAINING SECTOR

Examining again the four sub-goals of Recommendation 2.1 concerning a Canadian goal for CAL (see Section 5, Chapter 2), it is clear that sub-goal 4 ("a major contributor to productivity and effectiveness in all Canadian industries") is heavily reliant on the application of CAL to the Industrial Training Sector, and therefore should be considered paramount in any consideration of options within the sector.

However, activities in this sector are also highly relevant to sub-goals 1 ("a major employer of Canadians") and 2 ("a major contributor to the Canadian balance of trade"), and, as it turns out, has some applicability as well to sub-goal 3 ("a major contributor to Canadian Education").

On this basis, the following opportunities should be considered within the CAL Strategy:

A - Key-industry Targetting (pertains to sub-goal 4)
B - Knowledge Base Creation (pertains to sub-goals 4,2,1,3)
C - Product Documentation (pertain to sub-goals 4,1)
D - Taking Advantage of Sector Overlap (pertain to sub-goals 2,3)
E - Language Translation (pertains to sub-goals 4,1,2)
F - Registry Services for Industrial Training (pertains to sub-goals 1,4)

A - KEY-INDUSTRY TARGETTING

As part of a broader strategy, specific industries could be selected for special attention. These might be, for example, labour or knowledge intensive industries with a need for a competitive edge on the international market.

Once such industries have been targetted, strategic encouragement funding could then be applied as incentive for courseware development, courseware usage, curriculum planning, and knowledge-base creation (see below).

B - KNOWLEDGE BASE CREATION

Three basic CAL environments have been determined and are points in a spectrum of student-driven to system-driven teaching strategies.

THE THREE CAL ENVIRONMENTS

1 - DIRECTED

The learner is following a specific course plan with a fixed sequence, although the sequence may be dynamically selected, based on performance. The system directs the student what to read or watch, or presents him with specific displays of information, followed by questions/quizzes/games, etc., followed by more information. The learner does not choose what to do next. The system or teacher does.

2 - UNDIRECTED

The learner is provided with a "learning environment", which may include a number of sets of information presentation, in one medium or another, games and quizzes, a general glossary, bibliographies, checklists, and lists or menus of what items are available. The learner is permitted full freedom in selecting which items to use, and when.

3 - COACHED

The learner is provided with a "learning environment", as well as "coaching", which may be provided by humans or the computer system itself. In either event, the most normal implementation is one in which the learner can go to the "coach" for advice as to what to do next, and the "coach" maintains a checklist of items to be accomplished and what has been accomplished to date. The list may be used as success criteria for the one form or another of certification for the overall course of study, or may simply be another tool of the learner. Generally, coaching involves some form of "test". The test may be built into the activities which the learner can select, or may be offered the learner as part of the coaching process.

DIAGRAM 6

These environments, which are summarized in **Diagram 6** are:

- Directed (system-driven)
- Undirected (student-driven)
- Coached (mid-point)

As a general rule, if an environment for undirected learning is created it is relatively easy to add coaching to that environment, and, in fact, to then add a layer of direction above that. The reverse is not true.

Particularly among knowledge workers and clerical staff, the ideal on-the-job learning environment is one in which information is available whenever required (through "glossary", "query" or "browse", "simulate" and such functions), but coaching can be obtained when required, usually to learn something new or to clear up a misconception, through "tutorials" available on request.

In this context a knowledge base is a collection of information, checklists, and other learning aids concerning a specific subject, structured for convenient access in an undirected environment. Coaching and direction facilities may be added to a knowledge base.

In the past, when CAL was applied through dedicated terminals or equipment, the mix of on-job information search and off-job training was not possible because training was conducted away from the worker's desk and through training-dedicated equipment. In the near future the general workstation environment will be able to provide look-up facilities and training facilities through the same equipment and, therefore, ideally based on the same knowledge bases.

The opportunity facing Canada is to formulate standards, techniques, and tools for the development of knowledge bases, then, through strategic encouragement and strategic development to cause knowledge bases to be developed for certain target industries and subject areas. A forestry knowledge base, a Government Organization knowledge base and an automotive diagnostics knowledge base are some examples.

Once such knowledge bases were in place, a CAL sub-industry could evolve around each knowledge base, maintaining the information, adding new data items, providing presentation media, transporting it to new computer environments, and adding specialized coaching and direction capabilities. Such bases would also have great potential in the international marketplace, and would, in many cases, be directly usable in the Education Sector for independent research and study, and further modification.

C - PRODUCT "DOCUMENTATION"

Companies within Canadian industry manufacture many sophisticated and complex products, including products which are aimed at the large corporate office. The majority of these large corporate customers utilize computers widely, and it is not unreasonable to state that the vast majority of such companies will have computer facilities within the half decade.

As a means of increasing the attractiveness of many products, product vendors could be encouraged to provide much of their user instructions as dataware running under standard computer systems in the form of CAL.

Today, the vast majority of product-specific CAL is oriented to applications and products that are themselves computer-based products, since only with computer-based products can the CAL author be sure of a compatible computer environment to the CAL being developed.

Although this at first appears to be a major limitation to the market, it must be remembered that the vast majority of productivity and office-oriented products are, in fact, computer-based products. By 1990 it should be possible to depend on a stable set of interfaces to workstations that can ensure courses written within the necessary discipline an operating environment for their user training.

In order to prepare for this opportunity, a set of authoring tools for workstation-based CAL utilizing undirected and coaching methods will have to be in place. This will require Strategic Development projects and Strategic Encouragement funding.

D - TAKING ADVANTAGE OF SECTOR OVERLAP

There is a considerable overlap of content between Educational Sector and Industrial Training Sector subject matter. The vast majority of education in classifications A1 (career or professional) and A2 (update) could have equal application in university and industrial environments, and much of the content of classifications A3 (job-related) and A4 (job-specific) is required as well in college and trade school environments.

The implication is that if appropriate modularity and standardization in authoring methodology and tools could be achieved, Educational Sector materials could become available to industry, and even more important, key industry materials could find their way into university education, thus enhancing the relevance and currency of university-level content. In fact, over time, many courses from both sectors

could become available in the Consumer sector.

Note that this sector overlap can probably be utilized only if a shift is made towards knowledge base centred CAL.

E - LANGUAGE TRANSLATION

Still another advantage of knowledge base centred methodologies is the facilitation of translation of materials from one language to another. An opportunity exists, through standardization of methodology to encourage comprehensive translation of courseware from each of Canada's languages to the other, and to languages of other countries with which Canada does business as a prearranged activity for all registered courses, with translators and original authors automatically sharing royalty revenues from translated materials. A viable scenario might be one in which the Registry management deals directly with a "translation" sector of the CAL industry, providing contracts for translation of materials as they become available to the Registry.

F - REGISTRY SERVICES FOR INDUSTRIAL TRAINING

Besides the general registry function described in Sections 2, 3, and 5, and the background translation services described above, the course registry might well serve a purpose of "bulletin board" for new course proposals and requirements. For example, authors could post their "is anyone interested" proposals, and industry could post their "is anyone interested in doing one" requirements, and, as part of a service of the registry, proposed or required courseware could be rated according to such criteria as were discussed in Chapter 2 of this section. In this way the central registry concept might serve not only as a courseware marketplace but as a means of identifying opportunity.

The ratings themselves would help identify the best way to approach the development of required courseware. For example, courses rated H/H (high inter-corporate and intra-corporate audience scope) are potential "best-seller" opportunities for courseware product developers. Courses rated H/L are more appropriately offered through industry schools and manpower training centers, while L/H courses are best done by contractors for the company requiring them.

CHAPTER 5

WHAT IS REQUIRED FOR CANADIAN SUCCESS IN INDUSTRIAL CAL

The Industrial Training Sector is an essential element of any Canadian CAL Strategy that meets the goals recommended in this report. There are, however, a number of requirements to be met if success is to be achieved in this area. The following items are not necessarily uniquely required for the Industrial Training Sector; in fact most of them would enhance CAL in all three sectors. Nonetheless, they are requisites for success in industrial training.

A - IMPLEMENTATION OF KNOWLEDGE BASE CENTRED CAL

The organization of CAL offerings into a knowledge base surrounded by direction and coaching facilities has been described in Section 3 of this report and further discussed in the Chapter 4 of this section. This implies an entirely different methodology for CAL, new authoring capabilities and tools, and a different form of presentation environment.

Knowledge base centred CAL would have the following advantages to the Industrial Training Sector:

- Utilization of knowledge bases in on-the-job context as well as in a training environment.
- Enhanced learner productivity for already motivated adults who must be in a position to select what they need to learn.
- Greatly enhanced uploading and downloading capabilities for the distributed environment emerging in the corporate computing milieu.
- Substantially higher saleability of CAL offerings in this sector.
- Greatly enhanced facility for course translation and resale.
- Greatly enhanced capability for portability across operating system and equipment environments.
- Enhanced operation of a Registry with regards to the Industrial Sector.

The implementation of knowledge base centred CAL requires Strategic Development projects and Strategic Encouragement funding to accomplish:

- Design and development of a knowledge base access system
- Design and development of knowledge base creation tools
- Design and development of new authoring facilities and methods that support knowledge base centred CAL authoring

B - EXPANDED CAL REGISTRY STORAGE AND SERVICES

The fundamental service of the CAL registry, as described in previous sections of this report, include accepting, storing, and electronic delivery of course descriptions and courses, automated royalty accounting, and cataloguing and marketing services. It is further expected over time that many different media will be storable in the registry, including not only video graphics but digitized overhead and slide-materials, voice recording and voice generating capabilities, etc.

Additional accept/store/deliver capabilities that would be of value to the industrial sector include:

- curriculum, customization, and course development materials. For example a course outline for teaching claims-handling procedures might be more valuable than the course itself, because the amount of customization required probably demands an in-house development.

- sub-course modules, coaching tools, tests, and other material which could be incorporated into custom developed courseware.

- course management macros, such as error counting, error messages, glossary preparation tools, and other compilable materials.

Additional services which might be of great value when provided from a central registry include:

- contract language translation
- "Can do" and "Need" registration and access capabilities
- Registry-standard and on-demand fee-based rating and assessment services
- Corporate course usage/inventory tracking services

A great deal of additional storage and support services will be identified during the course of the strategy, many of which would be the responsibility of the registry staff, while others might be decentralized to the CAL support centres that the recommendations of Section 5 call for.

C - A DISTRIBUTED CAL CAPABILITY

Course presentation is best performed on as local a system as is available. Course development at best combines personal and central processing. Course storage, acccunting, and maintenance is best performed at a central level. Therefore the ability to upload and download CAL materials across a standard form of corporate network is essential to the emerging Industrial Sector environment. This entire capability will be greatly enhanced in a knowledge base centred CAL philosophy, but will further require Strategic Projects and Strategic Encouragement funding to achieve:

- Development of a distributed course management system, including the capability of automatic distribution of updates, and selective uploading and downloading of course modules and/or knowledge base subsets.
- Enhancement of NATAL as both authoring vehicle and conversion code standard to support distributed CAL.
- Availability of powerful CAL authoring facilities compatible with knowledge base and standard corporate operating environments.

D - ENHANCED CAPABILITY FOR PRODUCTIVITY IN AUTHORING

There are two major issues arising from the economics of industrial training CAL and from the great amount of customization requirement.

1 - The requirement of efficiency in preparation and delivery of CAL demands an authoring methodology that can cut to about 10% the standard number of hours to develop an hour of training. This is not only because of costs but because of

scarcity of the CAL development resource, and also because of the volatility of much of the material used in industrial training, requiring constant update and alteration. It is expected that knowledge base centred CAL can contribute to this goal, but additional research and methodology development will be required.

2 - Most large organizations have at least some education personnel who can become CAL experts. On the other hand, a great deal of the material which must be taught comes from content experts with little or no CAL or computer training. The standard solution of providing content experts with miniscule authoring function and instructional templates often fails because it produces poor education. Within the knowledge base environment it is possible to combine the efforts of educator and content expert by providing specialized facilities to the content expert to organize and load content into a knowledge base, with the educator then able to enhance the structure of the knowledge base and to add coaching and direction facilities. This requires new methods and tools that carefully separate the development of knowledge base from the application of educational expertise.

E - EXPORT MARKETING

Export marketing has been described as a general requisite, covering all three market sectors, for accomplishing Canadian CAL goals. Once the knowledge base orientation has been accomplished, it represents an immediate and major opportunity for Industrial Training Sector materials. Furthermore, because the industry sector is more limited for courseware products (high customization requirement, smaller total marketplace than the Education Sector), few products that do not have an audience scope of H/H can recover development costs within the Canadian marketplace alone. Therefore an essential requisite to encourage development of key courseware, besides development incentives, is the incentive of marketing it worldwide. For example, M/L materials will tend to find little competition on the world marketplace.

F - GOVERNMENT AS "MANDATORY" CUSTOMER

It is in the Industrial Training Sector that Government as customer has the most attraction. As a heavy user of training (B4), the Federal Government alone has the clout to make or break a strategy. In category B5, or as a customer of category B2, with some advance planning an entire sub-industry could be built around manpower

training requirements, with sufficient materials generated to easily spill into other categories as well.

G - INCENTIVES

Section 5 of this report discussed the use of Strategic Encouragement funding as a means of implementing a long-term strategy. Applications of this form of funding to the Industrial Training Sector would probably have strong benefit in at least the following areas:

- Development of knowledge base centred CAL, once specifications for this form of CAL have been produced.
- CAL language translation.
- Field trials (private and public sector) of strategic software and courseware.
- NATAL-based development of authoring facilities, conversion facilities, and distributed processing facilities for specified standard industrial environments.
- Usage of strategic CAL for internal training within targetted industries.
- Usage of CAL for product documentation.
- Conversion facilities for commonly used CAL systems within the Industrial Training Sector (e.g. PLATO) into:
  a) the NATAL framework
  b) common integrated corporate computing environments

H - STRATEGIC DEVELOPMENT PROJECTS

Several projects have been identified in this section as highly worthwhile development projects that would probably have to be Public Sector funded. They include:

- Development of a knowledge base centred CAL methodology.
- Development of tools and facilities for developing knowledge base centred courseware.
- Development of presentation environments for knowledge base usage.
- Conversion facilities into selected Corporate usage environments.
- NATAL enhancements for knowledge base centred authoring, usage, and storage, as well as for distributed environments.

CHAPTER 6

APPLYING THE CANADIAN STRATEGY TO INDUSTRIAL CAL

Section 5 of this report contains recommendations concerning the proposed Canadian CAL strategy and how to implement it. At the level described, it is entirely consistent with the requirements of the Industrial Training Sector (I.T.S.). To ensure that this sector is promoted to its fullest, the following features of the strategy must be emphasized:

- Measurable and specific objectives for sub-goal 4 (Rec. 2.2)
- National-level marketing for I.T.S. CAL (Rec. 2.4)
- Focus on productivity requirements of I.T.S. (Rec. 2.5)
- Ensure allocation of three types of funding to I.T.S. (Rec.2.8)
- Ensure representation of industrial users and associations of industrial trainers and I.T.S. CAL industry participants. (Rec. 2.11)
- Ensure NATAL enhancements address I.T.S. (Rec. 3.7)
- Ensure I.T.S. vendors supported for conversion (Rec. 3.10)
- Ensure I.T.S. compatible operating environments are supported for courseware development incentives. (Rec.3.11)
- Long and short range plans to address I.T.S. (Rec. 4.1)
- Include I.T.S. in Stage 1 surveys and activities (Rec. 4.2)

CHAPTER 7

DETAIL NOTES

This chapter contains two "detail notes", which are short articles relevant to industrial training issues raised in previous chapters. They are:

A - Industrial Training Significance - Chapter 1 Rationale
B - Obstacles to CAL success in the Industrial Training Sector

The material in these notes is not meant to be comprehensive, but simply to add some additional insight into the topic matter.

DETAIL NOTE A

INDUSTRIAL TRAINING SIGNIFICANCE
CHAPTER 1 RATIONALE

In Chapter 1 of this section, three reasons were provided as to why the Industrial Training Sector is critical to any Canadian CAL strategy. The following provides more details on each of those reasons.

1 - Industrial Training Sector expenditures

Although expenditures in this sector are very difficult to measure, for some of the reasons described in Chapter 3, rough estimates of 1983 expenditures were at least $4 billion in Canada, including about $600 million by the military, about $1.3 billion by governments on manpower training programs, and about $2.1 billion spent directly by industry (however this figures includes about $1 billion which represents salary value of time off the job while being trained).

Applying the standard rule of thumb of multiplying by 10 to estimate U.S. expenditures, and doubling that for worldwide expenditures, the worldwide industrial training market may already be as high as $50 billion.

This figure, however, is not at all indicative of future potential. Throughout the world, the need for industrial training is climbing as productivity becomes more and more of an issue, as massive changes in working environment occur, and as skills requirements change rapidly. The constraining factor in the industrial training marketplace is by no means the requirement -- it is the cost and the unavailability of highly effective training methods.

With or without good CAL technology, the marketplace for industrial training is probably increasing at a greater level, particularly in the industrial nations, than the Educational Sector.

2 - Industrial Training Sector Impact on the Canadian CAL Goal

Recommendation 2.1 (Section 5, Chapter 2) describes a Canadian goal in which the CAL Industry in Canada is:

1 - a major employer of Canadians
2 - a major contributor to the Canadian balance of trade
3 - a major contributor to superior Canadian education
4 - a major contributor to productivity and effectiveness in all Canadian industries.

Of these, it is very clear that sub-goal #4 is directly affected by Canada's success in applying CAL to the industrial sector. In fact, CAL in the industrial sector has much to contribute to sub-goal #1 and #2, and can even have some impact on sub-goal #3 as well:

1 - Industrial sector CAL as an employer of Canadians.
Adult education and training is widely performed today in Corporations, Governments, and organizations such as the military. CAL can, by increasing the productivity of such training, increase its usage to a level in which the total amount of people employed for industrial training is increased. This is further enhanced when CAL becomes part of the product documentation process, as described in later chapters.

2 - Industrial sector CAL and the balance of trade.
Canada is today a net importer of industrial know-how and training. By helping Canada become a net exporter a CAL Industry can contribute significantly to the balance of trade. In fact, the total CAL export market for industrial training may well be greater than that for educational materials. The greatest contribution industrial sector CAL can make to the balance of trade, however, is indirect, through its impact on sub-goal #4.

3 - Industrial sector CAL and superior Canadian Education.
In today's world, education does not stop with graduation from educational institutions. Much of the general and professional knowledge of adults is gained at work, through directed and undirected exposure to job-related and other information. By providing a general learning atmosphere within the industrial sector, CAL can contribute on an ongoing basis to the sub-goal of superior education.

4 - Industrial sector CAL and Industrial productivity/effectiveness.
Industrial productivity and effectiveness has been recognized as a key area of concern to Canada's economy, as it affects our ability to compete in world markets, and to ensure satisfactory levels of Canadian employment. This is directly related to training, motivation, and innovation, all of which could be enhanced through highly effective usage of CAL.

3 - The Applicability of CAL to the Industrial Training Sector

CAL has a higher degree of immediate applicability in the Industrial Training Sector for several reasons, including:

- Most large companies are already heavily computer-based, trending towards a situation of terminals available to all white-collar employees. Thus general-purpose equipment is already on hand, or has justification for purchase beyond training.
- While many educational institutions and people, including teachers have a vested interest in maintaining the central role of the teacher in the classroom, most companies, not being in the education business, have an interest in reducing the number of teachers required by the company or industry.

- While CAL in educational institutions must overcome the inertia of much educational practice and tradition, and requires time for general acceptance by front-line teachers, industrial training personnel tend to have a less "established" environment, and an ability to accept new instructional technology with less culture-shock.

- While educational institutions, particularly at the primary and secondary levels must be highly concerned with many aspects of quality of education, including motivation, reinforcement, socialization, and integration of the whole person, the general concern of industrial training is to accomplish some specific learning goals. These are areas in which, rightly or wrongly, most people feel that CAL is least applicable, especially considering the quality of today's inventory of drill-and-practice type of courseware. These issues are less important in most industrial training applications. The material learned will be reinforced by immediate usage on the job, and motivation is derived from the immediate relevance of the material. Thus many of the educational goals for which CAL is today considered least applicable are not considered to be as significant requirements in industrial training.

DETAIL NOTE B

OBSTACLES TO CAL SUCCESS IN THE INDUSTRIAL TRAINING SECTOR

In Chapter 3 of this section, several economic factors in the industrial CAL marketplace were discussed. Two of these in particular can be considered obstacles to CAL success in this sector:

- The high customization requirement
- The trend towards multiple-user computers

Other obstacles which must be addressed fully for CAL success are:

- Lack of firm commitment because of lack of firm justifications

  Because there are few well established ways of measuring the value of education and training in terms of the corporate balance sheet, while there is a dominating hard cost of time off the job, the attitude of corporations to training and education tends to be wishy washy. At times corporate executives are highly enthusiastic, and insisting on new and broader training initiatives; at other times, training is the first victim of hard times. This factor results in high turnover of industrial training personnel, and in an uncertain marketplace, particularly during difficult economic periods.

- High current inventory of training investment

  In the area of CAL most companies entered through courseware to support computing. Therefore their purchases were of materials (usually "multi-media", meaning videotape and courseware) from vendors in the computer business, and the CAL and presentation systems to support these. Many of these organizations created no courseware of their own, so that the authoring capability of the systems they purchased were not an issue. Nonetheless, these systems have a strong penetration in the industrial marketplace, and improved systems must displace them or operate in conjunction with them.

- Confusion concerning who buys CAL

  Most companies have data processing departments who were the original purchasers and, in fact, users of CAL because the CAL tended to focus on computer subjects. Data processing is seen by many such departments as their territory, and CAL is seen as data processing. Then there is the personnel (or Human Resources) department which usually has responsibility for corporate training, particularly at the white-collar level. Then there usually is training responsibility in line departments, particularly in the case of blue-collar intensive departments.

  Of late, as more and more user departments themselves buy micros for personal and departmental processing, these machines also become "targets" for CAL systems and courseware, resulting in further fragmentation of the internal marketplace within large organizations for CAL.

- Computing trends within the large industrial environment

  The industrial marketplace today is a wilderness of incompatible equipment, operating systems, and communication protocols. This means that it is very difficult to produce a course that will run in multiple companies unless those companies are prepared to purchase dedicated systems of hardware and/or software on which to run the courses.

  Because IBM has tended to dominate the mainframe marketplace, most successful offerings of CAL systems and courseware in industry have been aimed at the IBM mainframe, including IBM's own products such as IIS. Such courses have the advantage that personnel that have terminals for the purpose of utilizing other computer applications can also access these courses, many of which have as their subject matter the other computer applications.

  Those products which are geared towards more ambitious training assume that the purpose of terminals will be for training, and therefore they design specialized terminals (such as PLATO) for dedicated training purposes. Products such as IIS tend to fail for non-general training (such as A4 and A6 content) because they are relatively poor

authoring systems and the degree of customization required demands in-house skills which are not readily available.

Thus the current situation is one of industrial CAL being dominated by a few computer-specialist companies (computer manufacturers such as IBM and Control Data as well as computer education vendors such as Deltak and ASI).

Fortunately, there is a major trend away from mainframe-based computing which, in truth, is not an ideal environment for CAL. This trend at first was expressed through user purchase of decentralized micro and other small computers, which appeared to open the door in industrial training to micro-based courses. There has been some success in using such equipment for dedicated training purposes, such as the education centre in a large company although in many companies this led to a situation of some courses running on micros and others on mainframe terminals.

The trend in computing within corporations, however, has not stopped at decentralization. The ultimate end is the fully distributed corporate network, encompassing mainframes, minis, and micros in a fully integrated environment in which all function and data can be accessed through a single workstation located at each person's desk. When this is achieved, industrial-sector CAL will come of age, because people will be able to take courses while in their offices, and to refresh themselves in a knowledge base environment at any time that they need information.

This new environment obsoletes the vast majority of the materials on the marketplace today, which is based on specialized terminals, mainframe-only operation, or running on micros with their own operating systems or esoteric operating systems that are not part of the normal corporate office environment.

The emerging marketplace for industrial CAL within corporations has the following requirements:

- Distributed:
  That is, materials can be developed on micros and uploaded to mainframes for storage and distribution, or developed on mainframes and downloaded to micros for presentation, or any combination.

- Compatible:
  That is, running under the same operating system environment as is in use in that corporation on both the micros and mainframes.

- Integrated:
  That is, integrated into the workstation environment of the user so that information can be accessed in the normal course of events, as "tutorials", "browsing", etc. Ideally, an office worker must be able to invoke CAL content while performing another computer application.

At first glance these requirements seem only to apply to CAL in the integrated office environment, and not to apply to dedicated training environments such as in classes B2 and B5, or even in the training department of a large company. While it is true that class B5 will particularly be able to for quite some time depend upon a stand-alone CAL training environment, and therefore on incompatible or non-integrated computing environments, over the next 5-10 years such environments will become non-viable for industrial training CAL because of their lack of applicability elsewhere.

- Efficiency requirements for the Industrial Training Sector
  The key purpose of CAL in industry is to improve the effectiveness of corporate performance.

BIBLIOGRAPHY

1. Burt, L. et al, Summary Report of the Symposium on National Concerns in Educational Technology, Association for Media and Technology in Education in Canada, Toronto, March, 1975.

2. National Research Council of Canada, Proceedings of the Fourth Canadian Symposium on Instructional Technology, Winnipeg, October 19-21, 1983.

3. Cartwright, Glenn F., "A Task-Oriented, Intelligent Context Editor for Computer-Assisted Instruction Course Authors", A paper presented at the Fourth Canadian Symposium on Instructional Technology, Winnipeg, October, 1983, McGill University.

4. Benjamin, Art, "The Software Industry in Canada -A National Priority", prepared for the National Science Council of Canada, Online People Inc., January, 1983.

5. Booth, A.D. et al, "Guidelines and Priorities for Research and Development in Computer-Aided Learning", Associate Committee on Instructional Technology, National Research Council of Canada, NRC 14894, August, 1974.

6. Hunks, S. et al, "Basic Guidelines for the Documentation of Computer Assisted Learning Programs", Associate Committee on Instructional Technology, National Research Council of Canada, NRCC 16954, Ottawa, September, 1978.

7. Associate Committee on Instructional Technology, "A Functional Specification for a Programming Language for Computer Aided Learning Applications", National Research Council of Canada, NRCC 13659, Ottawa, July, 1972.

8. Alberta Education, "Computers in Schools" - The Report of the Minister's Task Force on Computers in Schools, June, 1983.

9. Alberta Education, "Computers in Schools" - The Report of the Minister's Task Force on Computers in Schools - Executive Summary, June, 1983.

10. The Canadian Computer Industry - An Economic and Industrial Perspective on the Canadian Computer Industry; Electric & Electronics Branch of Industry, Trade & Commerce, July, 1980.

11. In Short Supply - Jobs and Skills in the 1980s, Economic Council of Canada, 1982.

12. Planning Now for an Information Society - Tomorrow is Too Late, Science Council of Canada Report, March, 1982.

13. The Future Population and Labour Force of Canada: Projections to the Year 2051, A Study Prepared for the Economic Council of Canada, Denton, Feaver & Spencer, Ministry of Supply & Services, Canada, 1980.

14. Learning at a Distance and the New Technology, Institute Research Program, Educational Research Institute of British Columbia, ISBN 0-919055-04-4, 1982.

15. Kearsley, Greg and Hillesohn, Michael J., "Computer Based Training: An Industry Survey", Courseware, Inc., VA, U.S.A., July, 1983.

16. Perusse, Pierre, "Instructional Technology in The Future Tense!", 1982 (Paper).

17. Lamb, M.R. (DP), "A Preliminary Survey of Courseware Authoring Languages", 1982 Ontario Ministry of Education.

18. Mason R.E.A. et al, "Exchange of CAL courseware", National Research Council of Canada, Ottawa, November, 1979.

19. Hallworth, H.J. et al, "Computer-Aided Learning in the Federal Republic of Germany", National Research Council of Canada, October 19-23, 1974.

20. "The Urgent Investment", A Long Range Plan for The National Research Council of Canada, Ottawa, October, 1980.

21. "The Development of a National Courseware Industry in Canada", ACIT Subcommittee B.

22. Simpson, Wayne, "An Economic Analysis of Industrial Training in Canada", Paper prepared for the Economic Council of Canada, ISSN-0225-8013, March, 1983, Discussion Paper No. 224.

23. Bliss, Michael, "The Evolution of Industrial Policies in Canada: An Historical Survey", paper prepared for the Economic Council of Canada, ISSN - 0225 -0813, June, 1982, Discussion Paper No. 218.

24. Plowright, Teresa, "Computer Learning: The Policy Imbroglio", A Study of the Policy Environment for Computer Learning and its Effects on Industry, A Report submitted to the Institute for Research on Public Policy, Wescom Ltd., July, 1983.

25. Atkinson, Richard C. & Wilson, H.A., "Computer-Assisted Instruction" - A Book of Readings, Academic Press, 1969.

26. Coburn, Peter et al, "Practical Guide to Computers in Education", Addison-Wesley Publishing Co., 1982.

27. Godfrey, David & Sterling, Sharon, "The Elements of CAL" -The How-To Book on Computer Aided Learning - ABC, A Softwords Book, Press Porcepic Ltd., 1982.

28. Godfrey, David & Parkhill, Douglas, "Gutenberg Two" - The New Electronics and Social Change, Press Porcepic Ltd., 1982.

29. Oettinger, Anthony G. with Sema Marks, "Run, Computer, Run" - The Mythology of Educational Innovation, Harvard University Press, 1969.

30. Pattis, Richard E., "Karel the Robot" - A Gentle Introduction to the Art of Programming with Pascal, John Wiley & Sons, 1981.

Appendix 2

THE DEVELOPMENT OF A COURSEWARE INDUSTRY IN CANADA

Report of the Subcommittee
on the Development of a Courseware Industry

May 1984

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THE DEVELOPMENT OF A COURSEWARE INDUSTRY IN CANADA

I. INTRODUCTION

At the November 1982 meeting of the Associate Committee on Instructional Technology, a Subcommittee on the Development of a Courseware Industry was formed. The mandate for this Subcommittee was the following:

> To examine ways to foster the development of Canadian skills in the utilization of information technology in order to create a widespread industry in courseware development and distribution and to develop a national strategy for implementation.

It is the intent of this paper to communicate the Subcommittee's views on the issues and possible strategies relating to the development of a national courseware industry. We hope that this paper prompts thought and a positive exchange of ideas among government, academia, industry and the Subcommittee to assist ACIT in the development of future policy.

II. WHY THERE SHOULD BE A COURSEWARE INDUSTRY IN CANADA

Definition:

Computer Assisted Learning (CAL) is any learning that is assisted or supported by a computer that runs software intended to aid learning.

1. Economic Reasons

Recent figures from Statistics Canada show that the domestic computer market has been growing by more than 20 per cent a year. Current annual revenues from sales of equipment and software programs are expected to triple to $17 billion by 1987. Figures released in early March 1984 by the Canadian Information Processing Society show that education is the largest industrial user of mainframe and mini-computers: 16.5 percent of the computers installed in Canada to date are in education. The manufacturing sector is second with 14.8 per cent. The problem is that the Canadian computer (hardware and software) industry is not benefiting.

Most of the productivity-enhancing products are imported from the U.S. and distributed by Canadian subsidiaries of American multi-nationals. A study by Evans Research Corp. in April 1984 shows that the large, multi-national computer companies that dominate the Canadian information processing industry are continuing to shortchange Canada in job creation (Globe & Mail, 6 April 1984). Canada's trade deficit in computers and office equipment alone in 1982 passed the $2 billion mark, nearly $1 billion higher than the 1980 figure according to the Department of Industry and Regional Expansion. Imports of computers totalled $3 billion for the year ended 31 December while exports totalled $890 million for a trade imbalance of $2.1 billion. An estimated $5 billion trade deficit currently exists when hidden costs such as consulting and training are included. According to Input Research

of California, revenues from professional services accounted for 57% of the total U.S. software market for 1979/80. Indeed, the majority of the growing deficit will accrue from the import of computer services in processing, consulting, training and education.

Foreign imports of computer hardware, software and courseware is costing Canada thousands of jobs. Only 30 per cent of the members of the Canadian Business Equipment Manufacturers Association (CBEMA) have a global product mandate program in which manufacturing of certain product lines is done in Canada. For example, from 1978-82, IBM Canada's revenue grew by 108%, a faster rate than in the rest of the world. However, although world-wide jobs at IBM increased by 13%, job creation at IBM Canada actually dropped 5% from 11,621 in 1978 to 11,068 in 1983 [Study by Evans Research Corp., April 1984].

The issue is not one of profit for some companies; it is one of establishing a Canadian industry. Far more critical is the situation that by 1990 Canada could have a balance of trade in information technology that is either +$10 billion or -$10 billion. Unless action is taken immediately to establish a thriving Canadian knowledgeware industry, the balance will be negative.

There is a Market to Tap:

Even if it is difficult to define and if there is no single, surefire way to tap it, there does appear to be a growing market for computer-based products. More specifically, there are three major components in computer technology: hardware, programware (software related directly to the hardware) and dataware.

Diagram 1 shows that in terms of the overall computer technology market, hardware represents the largest portion of the equipment market and decreases in importance to be the smallest component of dataware. The hardware market is dominated by American, Japanese and European manufacturers. Since hardware production requires large amounts of capital and increased competition is lowering profit margins, one may assume that this market area does not afford much opportunity for Canadian industry.

Canadian companies are now competing in the area of programware, however our small population base does not afford a domestic market of sufficient size to establish internationally competitive prices. Nevertheless, Canadian companies are entering specialized areas related to CAD/CAM, office automation systems and specialized telecommunications systems and software. As international competition increases in these fields, Canadian companies may be able to carve out a small portion of the overall market.

The third and largest area of computer technology is dataware. This area requires relatively small capital investments and is labour-intensive. Examples of dataware are:

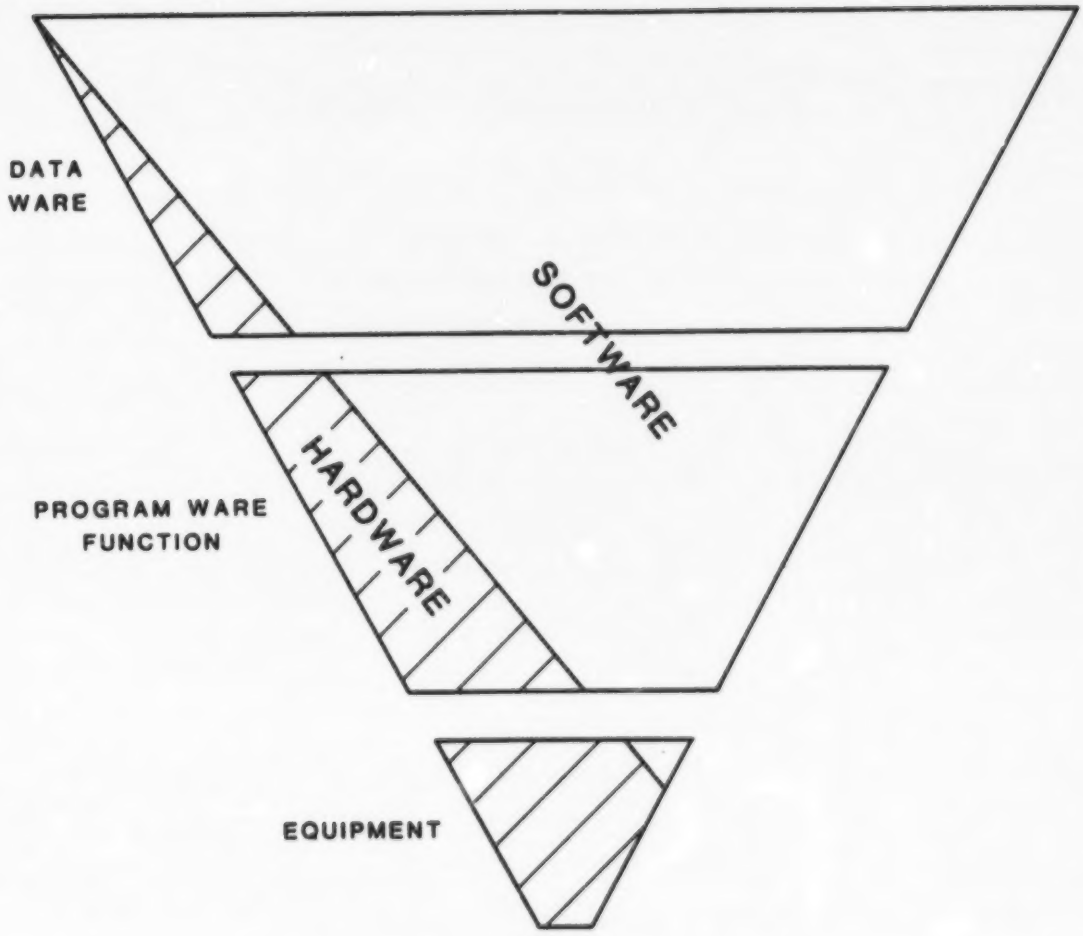
DATA
WARE
SOFTWARE
HARDWARE
PROGRAM WARE
FUNCTION
EQUIPMENT

Diagram 1

GROWTH BETWEEN 1980-1990

(SOURCE EDP IN-DEPTH REPORTS, EVANS RESEARCH CORP., VOL.12,NO 9, SEPTEMBER, 1983)

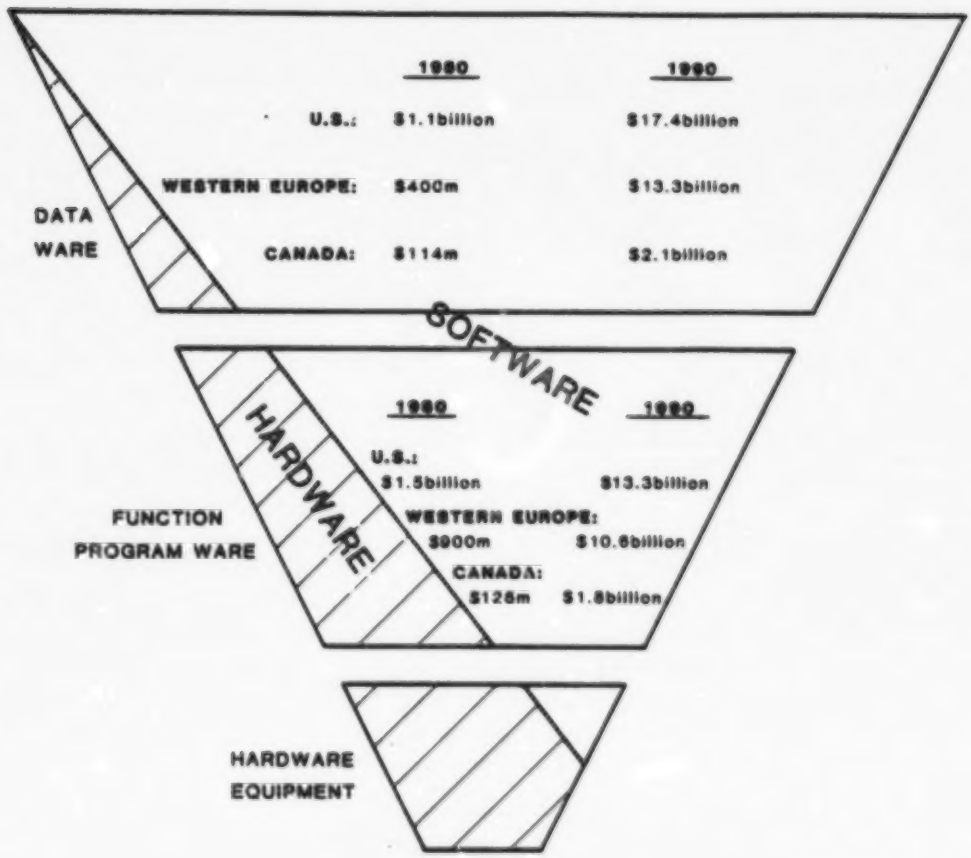

Diagram 2

TOTAL SOFTWARE INDUSTRY

	1980		1990
U.S.	$4.7billion	———	$44.5billion
WESTERN EUROPE	$2.6billion	———	$33.2billion
CANADA	$457 million	———	$5.4billion

- Databases — files of data used with company programs to produce information that they require, e.g. payroll processing. Information bases analysis is applied to raw data to produce an information base, e.g. Infoglobe, Dow Jones.

- Knowledge bases — Structured collections of knowledge about specific fields or procedures for accomplishing specific results e.g. CAL, LOGO, robotics.

This paper will focus on the opportunities inherent in knowledge bases of datawaare. This area can accommodate seemingly unlimited amounts of products. However, there is relatively little product currently available. Canada is well-suited to compete in this area, if it can consolidate existing efforts with a view to establishing a thriving CAL courseware industry as soon as possible.

Diagram 2 shows the value of the software markets in the Western world for 1980 and projects market values in 1990. (Computer hardware is not addressed since Canada imports almost all its equipment.) In programware, the U.S. is projected to have a 15:1 ratio to Canada by 1990 (EDP In-depth Reports, Evans Research, vol. 12, no. 9, September 1983). In the area of datawaare, Canada has the usual 1/10th ratio compared with U.S. figures. By 1990, the Canadian market grows to modest proportions. Although this area of opportunity continues to grow steadily in Canada, it will be matched by higher growth rates in other countries. Even so, Canada stands to hold its own in this market domestically and internationally provided that governments, industry and academia co-operate to their mutual advantage.

2. Industrial Training Needs

The current high level of unemployment in Canada is not expected to decrease. To maintain the level of employment and perhaps increase the number of jobs, it will be important to retrain those laid off because of technological displacement.

The Canadian CAL industry should be in a position to respond rapidly to these needs. On the one hand, it can produce the courseware needed in the retraining process so that we are not importing products for training. On the other hand, a thriving CAL industry, an industry that is labour-intensive, will employ many Canadians with a wide range of talents from technical to artistic to marketing to subject specialist.

3. The Canadian Cultural Mosaic

The Canadian cultural mosaic gives us an opportunity to provide courseware to any country in its own language and to design courseware in a manner that is complementary with other cultures. Canada's bilingual nature means that we have the ability to enter the English and the French courseware markets with equal strength.

4. Improved Domestic Environment

In order to establish a Canadian courseware industry, educational institutions must produce people well qualified to enter the CAL industry. In return, courseware provided by that industry may help produce a superior standard of education in Canada. A Canadian CAL industry ought to contribute to greater productivity and effectiveness in Canadian industry in general as people are trained efficiently with minimal loss of working time. If we can accomplish these ends, Canada will be in an advantageous position to export knowledgeware.

III. THE CAL MARKET

Market Areas

The market areas for CAL are difficult to characterize because there are relatively little data on CAL and even though industry is using CAL, it is reticent to give information about expenditures on training. Further, the CAL product is evolving to become a consumer product as well as an industry product and the institutions themselves are changing their traditional forms to accommodate adult learning and training both formally and informally. To date three market areas for CAL products are evolving: 1) education at all institutional levels from elementary to post-secondary level; 2) the work place involving industrial training sponsored by government programs and industry itself; 3) the home market where consumers provide a retail market for CAL products. Today, the industrial market offers the most potential for CAL. Despite the increasing numbers of microcomputers in educational institutions, the school market is politicized and fragmented. The educational institution market represents problems to most Canadian industry; however, it is highly strategic: school use normally leads to brand loyalty. The consumer market is growing larger but it is speculative. Products for this market include entertainment, instruction and tools for increased productivity.

1. Educational Institutions

The nature of the educational institutional market varies markedly from province to province and from country to country; however, it is a large and strategic marketplace. In Canada, annual spending on education represents about 8 per cent of Gross National Expenditures, almost all coming from government. In 1984-85, expenditures of over $32 billion have been forecast for education in Canada: about $21.4 billion for the elementary/secondary levels and $10.9 billion for post-secondary education and vocational training (Statistics Canada, Advance Statistics in Education 1983-84). While enrolments have declined somewhat, spending at all levels increases steadily. Despite the size of the educational marketplace, the CAL industry remains leery; provincial government policies, local school purchasing and the fragmented nature of market warrant caution.

Provincial activities to date have centred on hardware decisions and in some cases, software (an indexing project, MECC membership, educational consortiums, exemplary courseware, evaluation criteria). Although the provincial governments support 66 percent of the costs of elementary and secondary schools (Statistics Canada, Financial Statistics on Education, 1979-80), the decision to purchase microcomputers rests at the local school board level. The most popular computers currently are made by Commodore, Apple and Radio Shack. In Ontario, there is provincial support for the Icon, produced by CEMCORP. Provincial subsidies ranging from 30-85 percent are offered to school boards purchasing the Icon in the next two years. This has not deterred Ontario school boards from purchasing millions of dollars worth of American products. Within a school there is often a variety of computer hardware. By 1 April 1983 there were an estimated 20,000 micros in Canadian schools and both industry and education sources foresee rapid increases; for example, Evans Research considers one micro for every 30 students, or 190,000 units, by the late 80's to be a conversative estimate, and projections go as high as one micro per student by the mid-90's.

Awareness of computers is starting to have an effect on purchasing decisions; consequently, hardware decisions are increasingly based on the availability of good courseware as well as attractive price. Yet, without a sufficient amount of good quality Canadian materials, Canadian school boards feel compelled to choose American hardware and the corresponding body of courseware. The Minnesota Education Computing Consortium (MECC) has made inroads into every province. Schools, Boards and Ministries of Education have joined MECC to receive the courseware it produces for the Apple and Atari hardware. Canadian CAL suppliers eye the large educational market but there are several problems, the chief being the variety of hardware fragmenting the market and the rampant copying of disks.

2. The Work Place

This marketplace includes all levels of government and corporations that have requirements for job training and skills upgrading. Training is a major activity in Canada. A study by Teresa Plowright (Computer Learning: The Policy Imbroglio, July 1983) for the Institute for Research on Public Policy, estimates that Canadian government and industry spend close to $4 billion per year. Although this market is smaller than the education market it offers more attractive opportunities to CAL suppliers: there is very little unauthorized copying of courseware, there is a well-defined need and there is an expanding market as computer hardware with more power means smaller, less expensive machines affordable by small companies or by individuals for training at home.

Further, business opportunities for CAL exist at the microcomputer level for vertical markets such as banking, travel companies, insurance companies, advertising, retailing, accounting, etc. Some Canadian corporations have seen a business opportunity in their training needs. For example, B.C. Telephone obtained a licence to distribute the U.S. Hazeltine TICCIT system

in Canada and internationally. They are producing the courseware to meet their needs and will market TICCIT and their courseware to telephone companies worldwide. The courseware is also IBM compatible. Likewise, Hydro-Québec produces audio-visual materials with a view to marketing them in other French-speaking countries. In future, CAL will increasingly be used to support technical and hardware products thereby supplementing documentation.

3. The Home

It is estimated that 7 percent of homes in Canada and the U.S. have microcomputers. This is double the number of one year ago. Sales of micros in Canada were over $100 million in 1981 and were expected to be about $250 million in 1982 (Evans Research Corp., Globe and Mail, 23 Feb., 1982). Most micros were purchased by hobbyists or for business applications. However, other members of the family are starting to use them for entertainment and children's educational pursuits. The advent of programs such as Logo, mixing graphics with the teaching of educational concepts, is an example of the type of software that will be a "hit" in school and home.

The micro in the home is the key that will open the home to job and skill training, expanding continuing education opportunities and even provide small business opportunities in the information technology area. The distinction between education, work and leisure will increasingly become blurred. Statistics show that part-time and continuing education enrolments are increasing dramatically at the post-secondary level. This is a growing audience for educational products for the home. Advertisers are already examining how they can get products into the home to reach this audience. It is possible that advertisers will subsidize the delivery of their products to the home. This means that graphically attractive materials and "how-to" programs may be big sellers.

4. International Market Opportunities

The domestic market for Canadian courseware is small compared to the U.S. market and the market in the developing countries. Surveys in the U.S. show that some form of CAL is used in over 50 per cent of all educational institutions, compared with 15 per cent six years ago (Frost and Sullivan). By 1985 the prediction is for 1 million micros to be in place and the U.S. educational software market will total about $150 million. The school and home markets will contribute equally to this sum. This courseware market is predicted to be over $1 billion by 1987, with the home market accounting for 75% of the market (Future Computing Inc., December 1983). The Canadian market may be assumed to be one-tenth the size of the U.S. market.

In the U.S., the military has been the driving force in the use of computer assisted learning. The U.S. military training budget was $10.5 billion in fiscal year 1982 (Canadian Armed Forces budgeted $600 million for the same period). The U.S. military is noted for its support of new technologies in

instruction. Transfer of technology from military to private industry is common with the result that expertise has been groomed in specialized CAL firms. McDonell Douglas has recently reorganized to form two entities: one dealing with defence and aeronautics, the other dealing with information and training materials.

The size of the potential home market in the U.S. reinforces the need for Canadian courseware firms to export their products to the south. According to Future Computing Inc., the U.S. market for home educational software will grow from $206 million in 1984 to nearly $500 million in 1986, topping $700 million by 1987. Courseware for this market will be required in large amounts and for the near term the most successful will simulate different learning environments. Delivery of content to the home must be fast, reliable and reasonable in cost.

The focus for Canada's trade has traditionally been the U.S. followed by other industrialized countries. The global village and the global marketplace take on new meaning for the marketing of knowledgeware. Canada is not alone; other industrialized countries see that the global marketplace for their high tech products will help to avoid a negative balance of trade in the future. Canadian involvement in international organizations such as Intelsat, World Bank, IMF and several United Nations organizations provide an entry for our CAL products perhaps in tandem with Canadian telecommunications products.

The Third World provides another area of opportunity for marketing products to satisfy the enormous educational needs of a large portion of the world's population. Having been at a disadvantage for so long, many Third World countries are coming to insist on transfer of technology, co-operative programs and appropriate technology and training. Canada is one of the few countries that enjoys a good reputation in this area, having recently completed a successful bid to provide Brazil's domestic satellite system (Canada won the contract against a European consortium headed by France). Training is a major aspect of this contract. It signals the growing importance of training in the export of technology. Moreover, the economies of several newly industrialized countries are booming and there is potential for trade partnerships. Software development is an area of interest for these countries.

In sum, the market for Canadian CAL products is global and there are many new trading partners to be cultivated. A strong international market is vital to offset the small, Canadian domestic market and to produce a positive blance of payments.

IV. PROBLEMS AND ISSUES

1. Shortage of CAL Businesses in Canada

Currently in Canada there are some companies involved in various aspects of CAL but they tend to be small and, generally speaking, not aggressive exporters of their products. The result is that Canadian companies cannot

compete for large contracts even when the odds are in their favour. For example, the Department of National Defence (DND) let a contract recently for courseware to train maintenance technicians for the CF-18 aircraft that is being purchased. Although B.C. Telephone and Honeywell replied to the request for proposal, there was no Canadian-owned company that was large enough to compete for the contract worth approximately $5 million (twice the cost of the CAL hardware). The contract was awarded to McDonnell Douglas Astronautics of the U.S., a firm known for its quality of work and guaranteed service. DND recently let a contract for the building of new ships for the Navy; unfortunately, it seems that the CF-18 situation will be repeated. The expense of creating courseware, lack of financing and the smallness of companies reduce the chances of Canadian companies entering the market and thriving. Also the current industrial structure retards Canadian capability to meet CAL market needs. For example, it is difficult to find Canadian firms that can provide turnkey systems for CAL; that is, the hardware, software and courseware. Rather, the various components are scattered. It is difficult and time consuming to coordinate the different aspects. Besides, people trained in one area usually do not understand the other and consequently, they do not easily work together.

2. Cost of Content

While the cost of computer hardware continues to fall, the cost of developing CAL products remains high because it is labour intensive and the labour is costly. It can take 200-300 hours of development to create one hour of courseware. A ratio of 100:1 is considered very efficient. Because the cost of custom-made coursewar appears to be prohibitive, many educational purchasers opt for a ready-made, off-the-shelf product. Alternatively, teachers are encouraged to create courseware for the micros in the schools but only a small percentage are capable of this.

Meanwhile, commercial software producers are creating products that will satisfy the needs of industry, schools and the home. In the latter case, products are meant for the masses and are sold at competitive costs. Development costs are high in both training and education and there is an ongoing search for ways to reduce development costs. Costs can be amortized through sales and licensing arrangements. They could also be reduced by sharing production resources.

Those involved in the creation of courseware for microcomputers face another dilemma: the different kinds of micros that currently exist fragment the meager resources available for content creation. For example, the CAL supplier is forced to choose a micro for which to design the courseware. Usually the choice made reflects the size of the hardware population; however, the more popular the micro the more competitors there are in the content area. For example, Sofsearch International, a U.S. research firm, estimates that there are 6,258 educational programmes available. According to Swift's Educational Software Directory, one-third of these titles run on Apple hardware. Hardware incompatibilities make it difficult for the CAL supplier to create content for a critical mass that permits large number of content packages to be sold at low cost.

Costs of content are tied to the enforcement of copyright laws. Each time a diskette is copied in a school or at home the author is losing revenue (businesses seldom copy the expensive software programs running on large computers). Copying disks is so prevalent outside large business that software producers estimate that for every program sold ten will be copied. Some technical steps may be taken to deter the novice copier but the ardent enthusiast will rise to the challenge. Licensing agreements (the right to copy under conditions) help the situation and there is a growing body of public domain software meant for free copying and use. The Ontario Ministry of Education is giving seed money to courseware development with the understanding that it has the provincial educational rights to the product.

In the education marketplace there are a number of content supply problems: varying quality, inadequate channels of supply, non-standard evaluation techniques and lack of public domain courseware, to name a few. In the field of training, lack of content is usually related to the high costs of custom-made courseware. The quality of educational content comes under constant criticism and it is usually associated with lessonware created by teachers for their own classes. As the mass of content grows, market forces favour certain programs and these become the "hits" with the teachers. Increasingly, software content producers are striving to make one product to serve the needs of school and home. Quality aside, this will affect the traditional pattern of education since children can learn the same material at home as in school.

It is ironic that as more educational content is developed for micros it is more difficult to know what is available and how to get it. Distribution channels for this type of courseware need to be established. Telecommunications delivery and clearing houses must be explored to organize and disseminate courseware.

The concept of public domain software is becoming popular. It is recognized that some software is unprofitable for entrepreneurs to develop (the costs are too high, the market is too small and those who need it do not have the funds to purchase it). Courseware that may contribute to Canadian culture and understanding, to equal opportunity or to solving local problems is likely to be commercially unviable. Such software could be contracted for or produced by a public agency (TV Ontario for example) with public funds and then be put in the public domain. Portability standards need to be enforced and a distribution strategy developed.

3. Shortage of Expertise

Canada is a large country with a small population base. Both these factors impinge on CAL courseware development: there are few people with CAL expertise and they are scattered across Canada. For example, a number of tenured positions in Educational Courseware lie vacant in Canadian universities; this situation is unheard of in other disciplines.

The Canadian companies devoted to courseware creation are small. Some computer hardware companies have small groups to prepare courseware to demonstrate the power of the hardware. Other industries with training needs create their own CAL courseware (Hydro-Québec, Gulf, B.C. Telephone). Some courseware is developed in universities (Québec, Alberta, Victoria) while the federal government uses courseware for their internal needs (DND). All of these efforts are small and uncoordinated; in general, they do not lead to the development of a thriving industry with products that Canada can sell to other English and French speaking countries.

In sum, sufficient highly qualified CAL expertise is lacking in Canada. Many of those Canadians who do receive training go immediately to the U.S. where there is a market for their skills. Without doubt, there is a need for people with skills to design, author and produce content, to train teachers to use computers for learning, to establish the infrastructures (consortiums, clearing houses, production centres), to set up marketing vehicles for CAL products, to do research, etc. Since we have a two or three year window to develop a CAL industry in Canada, the establishment of the necessary infrastructure to man and support the industry becomes critical.

Lack of marketing expertise seems to be a Canadian trait. It is no surprise that little market research has been done. Likely none of the small companies have the funds to do it. No government agency has offered to help (after all, under whose jurisdiction would this lie?). If help was forthcoming, where would one start? Advertising courseware is a vital part of marketing but the costs are usually as high as the costs of production. This means that little advertising is done, a fatal blow for anyone involved in producing courseware for micros. The creation of expertise in all facets of CAL development is critical.

Another problem is inadequate export financing instruments. Canadian banks have only recently begun to develop expertise in export financing and private companies play a minor role. Therefore, while it is acknowledged that Canada must compete internationally in the high tech/knowledgeware field and that exports are critical to a positive balance of payments, Canada's capabilities to market globally remain inadequate.

4. International Positioning

Many countries have recognized the importance of a positive balance of payments tied to the development of a computer hardware and/or software and/or courseware industry. For example, both Japan and France have committed massive funds to long range projects (Fifth Generation Computers and the Centre Mondiale respectively). The U.S. has de-regulated AT&T and IBM so that they may compete better in the international forum and it is funding R&D via the military and science foundations. In Britain, the government has established a procurement policy to induce the purchase of certain microcomputer systems and from 1972-77 had a program (the National Development Program in Computer-Assisted Learning) to stimulate the creation of

CAL courseware. In 1980 the "Microcomputers in the Schools" project was initiated. Taiwan, Hong Kong, South Korea and Singapore have enormous government support to establish their future stake in the knowledge industry.

5. The Timeframe

Some countries began to prepare their economies for the onslaught of the microelectronics revolution in the 1970s. Developments in hardware and software have since occurred that could not have been anticipated; for example, the exponential increase in the number of micros and the accompanying plummet in prices. Canada has stood still. Time is growing short, waiting is no longer an alternative. By 1987, Canada could have a balance of payments in information technology that is either plus or minus $10 billion. It will be positive if we assert that the development of a Canadian courseware industry is a national goal and then put the needed resources into the building of that industry. It will be negative if we continue to stand still. We have a three year window to establish a Canadian CAL industry.

6. Financing/Funding

It is often noted that other countries spend more on R&D activities than Canada. There is little doubt that R&D is essential to the development of Canadian CAL products; for example, research into areas such as intelligent response, natural dialogue, etc. In the short term, research is required to meet market needs (e.g. portability of software, interactive graphics). Long term research is required to place Canada in the forefront of courseware development.

The majority of R&D projects do not produce viable products but this does not negate the value of the R&D process. Of late, the government has assumed the unenviable burden of trying to pick a winner by awarding R&D funds to industry. There are many problems associated with such action: the decision making and bureaucratic process is slow and this affects projects; how can the "right" company be chosen; government decisions are often isolated from the marketplace and, finally, the government usually has its own ends to consider (e.g., regionalism).

Industry views the solutions to the problem rather differently. It needs money to create software and money to acquire software. Venture capital is needed to provide the necessary support. One of the problems, however, is to find an accepted measure so that a cost/benefit analysis on software may be carried out to assure investors. Tax shelters for investors may overcome the reticence of risk capital. An alternative would be for industry to be allowed tax write-offs for R&D projects. Each province has laws governing tax write-offs for R&D projects, but generally a 100% write-off on expenditures is permitted in the year that the expenses occurred. Since November 1983, tax credits may be claimed for R&D expenditures. It is not clear which CAL research activities will qualify. A climate is needed whereby

industry itself is encouraged to invest in short term R&D projects. An environment where there is seed money for projects and consortia formed to produce products is required.

Government supports R&D in its own labs and in universities. Long term research and research requiring highly specialized equipment and environments are best suited for this funding. However, under the current government science granting structure, CAL courseware development is not recognized as a valid project for funding. Such projects are interpreted to lay outside the jurisdiction of the various institutions involved.

V. PROPOSED SOLUTIONS

1. The Long-Term Model

While advocating that a number of steps should be taken immediately to establish a Canadian CAL industry, the Subcommittee feels that there should be some models examined that would firmly establish such an industry within a 3-10 year timeframe.

A thriving Canadian industry in CAL implies five activities:

1. Canadians developing CAL software systems for the development and presentation of courses.

2. Canadians developing and manufacturing equipment to support course development and course presentation.

3. Canadians developing, packaging and teaching course authoring methodologies, knowledge and techniques.

4. Canadians developing courseware.

5. Canadians storing, marketing and distributing Canadian software, hardware and courseware and courseware design knowledge products domestically and internationally.

Considering the number of people required in the industry and the purpose of CAL activity (4), Canadians developing courseware represents the most attractive objective that Canada can have in the area of CAL. That is, it represents the biggest opportunity for participation by the largest number of Canadians, it can reduce the amount of courseware that must be imported for use in Canada, it can be tailored to meet the requirements of education, home and industry, it is relatively undeveloped, and it is an area in which Canada can compete internationally.

Assuming that a Canadian courseware industry is developed, then activity (5) becomes very valuable. It is important to have a mechanism for export marketing (courseware in particular) to achieve the volumes necessary to provide good profit incentive. Canada, domestically, is seldom a large

enough marketplace to provide more than a minimal payback for software, hardware and courseware products.

Activities (1), (2) and (3) become important supports for the development and marketing of Canadian courseware products. Although there is always a marketplace for CAL software with improved presentation and management, it is most important that Canadian software support Canadian courseware. Likewise, once a good Canadian software environment has been identified, there is probably a good opportunity for hardware to support it, particularly in the area of presentation. Ironically, it is Canadians developing courseware that creates the demands for hardware and systems software development and the fostering of talent to man the industry. There are a number of factors that support a major Canadian courseware industry:

(i) A Canadian Courseware Repository. A "Library of Congress" type of repository system, whereby all courses could be classified, rated for reliability and catalogued. This would enable schools and other educational institutions to utilize courses in the repository more readily. Usage tracked for royalty purposes would be a strong incentive to authors.

(ii) A Coordinated Marketing Program: Through public and private sector initiatives, a major marketing campaign to sell Canadian courseware internationally would be a major factor in the success of a Canadian courseware industry. This could operate to market actively existing Canadian courseware internationally and to contract at a national level projects for major CAL needs for other countries. In such a scenario, Canada would undertake to develop CAL courseware to meet the educational requirements of another country and then project teams would be established to fulfil the contract.

(iii) A Standard Authoring Language Plus Instructional Dialogue Design Knowledge: A Standard Authoring Language increases the efficiency of training people to author courses, permits the use of a single set of courses in Teachers' Colleges on how to use the language and establishes a more mature industry.

There are a number of roles for co-operative vehicles in relation to the activities and factors noted above: preventing fragmented activities in the execution of a strategic model, avoiding technical incompatibilities that further segment the marketplace, sharing of resources and risks and establishing policies to nurture a favourable climate for the growth of a Canadian courseware industry. The cooperative vehicles might take various forms:

(i) Educational Computing Consortia. Such consortia tend to disperse the risk of starting up courseware agencies over several funding bodies thereby sharing the fiscal risk. For example the Manitoba Computer Assisted Learning Consortium offers over 200 educational programs to their client schools for Radio Shack TRS-80 III, Commodore Pet and Apple computers.

(ii) The Council of Ministers of Education (CMEC). This vehicle was established in 1967 to provide co-operation among the provinces in areas of mutual interest and concern in education. Ideally, it could co-ordinate provincial activities that will support the national strategy.

2. Key Considerations

Many activities currently exist that are related to CAL and/or a Canadian courseware industry. The question is how to get from these myriad activities to the stage where a strategic model can be established and working. We cannot afford to wait for bureaucratic wheels to be put into motion.

In her study, Computer Learning: The Policy Imbroglio, Teresa Plowright outlines seven strategic areas in CAL development. They are listed here to prompt consideration of what we have now and how we get to a future model. These considerations are valid in relation to immediate as well as long-term activities. Government support should be directed towards the following seven categories of activity:

(i) Increase knowledge - This includes cultivating a receptive environment for CAL (e.g., computer literacy, teacher training) and the establishment of resource centres.

(ii) Organize content supply - Encourage clearinghouses for indexing, cataloguing and evaluating content. Establish licensing arrangements, disseminate courseware, establish networks for distribution of courseware.

(iii) Organize the hardware market - Set standards and amass larger markets through bulk purchasing. (This may help the domestic market but it does not help Canadian courseware authors internationally).

(iv) Act as a catalyst user - Through purchase and use of equipment and the development of applications.

(v) Fund R&D and exemplary projects - This will demonstrate the benefits that have been claimed for CAL. The Request for Proposal process may stimulate business interest in CAL.

(vi) Subsidization - Give money to fund software and courseware, fund user markets.

(vii) Create supportive conditions of business - This may be done through favourable tax conditions, financing aid, export market support, international trade agreements, beneficial treatment of software and courseware as a product, and a more accommodating telecommunications policy.

VI. RECOMMENDATIONS

1. Canada faces a major opportunity to develop a CAL industry and requires a STRATEGIC PLAN to take advantage of that opportunity. Recognizing the present "window of opportunity," governments should commit themselves to a comprehensive, cooperative strategy that contains at least the following five elements.

2. Existing federal and provincial programs supporting the development of this potential industry should be given immediate enhanced financial support. For example, the Federal Government should enhance the marketing support for Telidon and NATAL and other developments suitable for courseware.

3. International marketing of Canadian developed CAL should be vigorously pursued.

4. ACIT should arrange for the necessary discussions to establish the agency or agencies which would coordinate the developments and projects proposed herein.

5. The provincial governments should enhance the marketing and further development of courseware, lessonware and utilities and hardware.

6. A repository of Canadian courses available should be accumulated and maintained.

Appendix 3

SUBMISSIONS AND ADDITIONAL REFERENCE MATERIALS RELATING TO A POLICY FOR A COMPUTER-ASSISTED LEARNING INDUSTRY

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*Reprinted from Proceedings of the Fourth Canadian Symposium on Instructional Technology, Winnipeg, October 19-21, 1983.

Introduction

During preparation of the report by the Associate Committee on Instructional Technology on a Policy for a Computer-Assisted Learning industry discussions took place with a number of individuals and organizations that are involved in or affected by the technology. Comments on the early drafts of the report and on the topic in general were requested and have been incorporated in the final draft. In a number of instances, formal written submissions were provided and they have been presented in this Appendix to provide an indication of priorities from specific points of view. We have also included the three papers, presented at the Fourth Canadian Symposium on Instructional Technology, that describe current activities and policies in the provinces of Quebec, Ontario and Alberta.

Kanata High Technology Training Association

Jim Sweezie

There are several factors affecting society today that make the need for a new approach to training critical to Canada's current economic well-being. The "baby boom" generation is currently in their late thirties and well past the traditional formal educational period (ages 5 through 19). The rate of change in technology is rapid and has significant impact on both the job skills required in the high tech industry, as well as the job skills in all the other industries that are and will be impacted by this technology. All employees must continually update their skill/knowledge base just to stay current, let alone advance. The traditional lead times to identify, analyze, develop and integrate these technology changes into the current school system make it impossible for that system to respond to industry demands in a time frame that is useful.

The Kanata High Technology Training Association (KHTTA) has, for the past year, been developing computer-based courseware as a potential solution to this problem. KHTTA believes computer-based courseware that is very modularized, competency based by educational design, and easily accessible, is the best solution to industry's employee training problem. The following memo higlights some of the potential roadblocks and some suggested solutions in creating an industry that could produce sufficient courseware to have a real impact on Canada's future.

We start by stating what may be considered obvious or trivial assumptions, but we feel it is important to keep the goals clearly in sight.

First, the courseware must fill a learner need and second, the cost of courseware must be within acceptable market tolerances. The most elegantly developed piece of courseware that no one needs is not useful nor is the perfect solution to a learner problem that costs five times what can be afforded.

Expanding on the problems associated with these two assumptions KHTTA identifies several critical areas:

First on the idea of responding to learner needs:

- the learner is not always able to express needs in terms useful to a course developer;
- the time frame in which a solution is required may preclude the traditional lead times for courseware production; therefore, many people go for a "quick and dirty" option;

- there must be controls to ensure the courseware being developed does meet the learning objectives established by the user;

- the quality of the final product must meet user expectations; therefore, it must be possible for the user to control all stages of development.

Second, the costs of producing courseware to meet user needs must fall within market tolerance:

- there are no established standards against which courseware development costs can be estimated;

- currently accepted guidelines (e.g., of 100 to 50 days of development to one day of courseware) are unacceptable from a cost point of view;

- unless the demand is sufficiently large to allow amortization over a large number of users, investment money will not be available to fund courseware development;

- a national curriculum needs to exist to allow individual needs to be relative to larger national standards to facilitate the amortization of costs.

It is KHTTA's belief that these concerns will need to be addressed if there is to be a rapid growth in the production of high quality, useful courseware in Canada.

The recommendations that follow are KHTTA's attempt to develop procedures and tools that will be used to solve these problems.

1. Learner Orientation

The starting point for all development is the learner, not the teacher. With this in mind, a system needs to be put in place to support the learner first, the teacher second and the administrator/manager third.

The system must help the learners to:

- identify their needs
- express their needs in an organized manner.

2. Formal Process

KHTTA is investing an effort into documenting a formal process to identify and structure user training needs. The emphasis is on capturing what the learning requirements are and validating what the performance standards for those requirements should be.

3. Fifth Generation Learning System

To date the process is manual and predicated on the use of paper-based check lists and design templates. There is a definite requirement to develop a "fifth generation" learning system tool to allow this process to be automated from the earliest user/learner contact. The learner system must incorporate access to a national standard curriculum data base to allow individual needs to be expressed relative to a national standard. The objective to express an individual need as common with any individual (i.e., national standard) is to justify the investment dollars for courseware development.

4. Standard Cost Mode

To ensure continued financial support, estimated project costs must be accurate; therefore, there is a need for the creation of a standard costs model for courseware production.

5. Productivity Tools

The next objective of the learning system would be to reduce development time (costs) through the automation of all of the clerical aspects of the writing, analysis, design and graphic production stages of development.

6. Formal Quality Review Process

Inherent in the concept of a "fifth generation" system is that the system is under user control, thus ensuring quality and applicability concerns are met. From the user point of view, the system must be self-instructing (it must practice what it preaches), for obvious ease of use reasons but also to provide the user/learner with the need identification and needs analysis skills they generally lack.

7. Centralized Development

KHTTA is focusing on the analysis and design phases of the development cycle. We can only assume the hardware/software systems will continue to evolve and that our design will have to adapt to this new technology. However, with today's state-of-the-art technology, we are adopting a centralized large system development environment and a distributed micro-based delivery environment. The criteria for these choices are based on the needs:

> for rapid communication between development team members and access to large data banks of sharable information;
>
> low-cost, delivery responsiveness, distributed to potentially remote locations (e.g., northern communities, oil-drilling platforms, etc.).

The resources (money, committed people) are required to focus on several key areas:

- creation of the national standard curriculum database;
- formation of a network of centres of expertise in computer-based education;
- research and development of a user-based learning system;
- research and development of a "fifth generation" computer implementation of this user-based learning system;
- focus on the national and international marketability of both the system and the courseware produced by the system.

****

Compris Incorporated

E.O.H. Davies

Submission to the National Research Council of Canada on the Need for a Computer-Based Learning Industry

Compris Inc. was federally incorporated in 1977 and has acted as consultant in computerised education and training; it has produced numerous courses for education, business and industry, customised and off-the-shelf.

It is the opinion of Compris that despite the need for computers in education and training, and despite the possibilities that have existed for at least two decades, computer engineers have been in advance of the thinking of educators and trainers. The present dearth of experts in instructional design, the lack of programmers in high-level course-authoring languages, the non-involvement of expert graphics and frame designers, and the need for blending these, together with subject-matter expertise and teaching/learning experience, into a team is the result of these years of lack of vision.

Although training is now being given to "educational technologists," and graduates of courses will no doubt play a vital part in the production of courseware, they are not now trained to the level necessary, and which we have designated "expert" in the required fields.

Currently, industry in Canada in particular lacks expertise in Computer-Based Training. A great deal of money has been, is being, and will be spent by industry in learning what not to do. Much of this money is from the public purse.

Compris would like to see a truly national, federal, and provincial move to assist computer-based education and training development. It has long been apparent that a Registry of evaluated courseware is necessary. A registry would make a start in this field, so long as the evaluators are carefully evaluated. It would, while providing a start, give time for consultations between education, business and industry, to determine the needs and the levels of cooperation.

Whatever cooperation is achieved, it is our belief that manufacturing companies will continue in the main to regard others as market rivals, and will attempt to protect rather than share their singular and vital expertise. At the same time, they will be prepared to purchase from a central bank anything that will enhance their own operation. It will be necessary, therefore, to attract people of the highest calibre as a working nucleus and to train company personnel to adapt and enhance courseware to and for their own needs. The experience will, of course, benefit both sides and may eventually break down many of the barriers to sharing that now exist.

There is, in all of this, a long learning curve. Only now are companies who are entering this field becoming aware that instructional designers are the key to the process, that it takes considerable time to produce such an expert, and that the best courseware takes a considerable time to produce, even by experts.

Apart from the domestic market, and the help given to production by better and faster-trained employees, there is a very large export market. Compris believes that Canada is still ahead in its conceptual uses of the computer in education and training. But only just. Time is of the essence. The rest of the world is not waiting for us.

If some special pleading may be allowed, we would like to add that Compris, and small companies like it, cannot continue to make the necessary thrusts in export markets without support. It cannot compete with publicly-funded educational and training institutions, many of which do not have the expertise and are producing courseware of an insufficiently high quality.

Further, Canadian copyright laws should be strengthened to protect more adequately the time, effort and money courseware houses are expending in a field of vital national importance.

****

The Manitoba Computer Assisted Learning Consortium

Lauran Sandals, Ph.D.

Over the last ten years in Canada, the U.S.A., and other countries such as Holland, we have seen the growth of educational computing consortiums that have allowed the development of both a high quality and quantity of computer courseware with many apparent advantages for the contributing agencies.

Educational computing consortiums tend to disburse the risk of starting up courseware agencies over several funding bodies and this encourages each partner to participate in a shared fiscal arrangement plus the governance and policy-making decisions of the organization. In many ways the educational consortiums are analogous to the many farmer cooperatives that have been running on the prairies for the last forty years.

One of the principal educational computing consortiums in Canada has been the Manitoba Computer Assisted Learning Consortium which is cost-shared by the Manitoba Department of Education, Community Services, 16 Manitoba School Divisions and the University of Manitoba. In the United States, the major computing consortium is in the State of Minnesota where the Department of Education, School Boards, and the Universities and Community Colleges support a multi-million dollar organization. Other computing consortiums are also found in Wisconsin, Florida and California. In countries such as Holland, the major funder of the consortium is the Teachers' Society with smaller contributions from other agencies.

HISTORY

The Manitoba Computer Assisted Learning Consortium began in 1973, under the coordination of the Manitoba Department of Education, the Department of Community Services, the University of Manitoba and various school divisions. The Consortium was charged with the responsibility for developing interactive computer programs for special need students. They began producing remedial programs for teletype terminals guided by the philosophy of the Consortium Board and the resources of their research team. But more than anything else, they relied on teacher input and student feedback. The organization and expertise developed at that time, and they were easily able to incorporate the new microcomputer technology as it became available. The number of client schools has steadily grown to the point where they are now the largest consortium of its kind in Western Canada.

THE PRESENT

They offer over 200 educational programs to their client schools and support service for implementing computer assisted instruction for regular academic students as well as special needs students. They have a full slate

of programs available for the RADIO SHACK TRS-80 III and many programs for the PET and the APPLE computers. All programs are supported with full descriptions outlining objectives and topics, sample runs, and data listings when needed.

PRESENT AND FUTURE OBJECTIVES

To develop Canadian content courseware that reflects sound instructional design principles and takes maximum advantage of the capabilities of each of the three main types of educational microcomputers in direct support of the Curriculum Guides approved by the Manitoba Department of Education under three major strategies:

1. Support appropriate Manitoba authored software by purchasing the copyright from authors whose software is of excellent quality;

2. Enter agreements with companies to "Canadianize" selected programs for which they hold copyright in return for the exclusive right to distribute the "Canadian" version in Canada; and,

3. Utilizing a "multidisciplined authoring team" approach, to develop new courseware to meet Manitoba (and Canadian) needs.

To distribute all courseware to all educational institutions in the province of Manitoba at "dubbing" costs only.

To distribute all courseware to all other areas of Canada (and the world) at existing market prices with the operation obtaining a "self-sufficient" status financially before or within 5 years of establishment.

PRODUCER CONCERNS

1. Piracy and Copyright Violations.

2. Clones and/or Imitations of Original.

3. Development Time - 30/1 - 100/1.

4. Incompatibility of Hardware-Conversion.

5. Advertising Budgets vs. Development Costs - 6/1.

6. Field Testing/Research.

7. Two-Three Years from Idea to Classroom Package.

8. Quality of Documentation Package.

9. Maintaining Product Integrity.

10. Curricula of any Breadth/Giant Risk.

11. No National Consensus on Curricula.

12. Case Study vs. Meta Analysis Evaluation
Alberta, Ontario, Michigan, Florida, California, Microsift, EPIE.

13. No One BEST Piece of Courseware
Some Think There is, Reading Analogy.

****

Bank of Montreal

J.A. Douglas

Since 1975 Bank of Montreal has trained 45,000 people using C.A.L. as a major part of their training program. As micro computers, office automation systems and on-line systems proliferate we expect to move our use of C.A.L. into other occupational areas. As a major user of C.A.L. we would like to see a good variety of C.A.L. products and services available in Canada as part of a Canadian initiative. In order that we can consider these products and services, however, they must be comparable in price and quality to those services available outside Canada.

I think that Appendix I of the report listed quite clearly some of the essential differences between C.A.L. in the public education area and C.A.L. in Commercial Training. Let me re-emphasize some of the characteristics necessary for Commercial Training:

- It must be cost effective in both development and delivery. Most notably, development ratios must be considerably lower in the Commercial Training area because of the much smaller target populations.

- Much C.A.L. must be designed to be delivered through already existing on-line or office automation systems. Very rarely will it be possible to make available special purpose training terminals or systems. Products must have all the capability necessary to compete with those from off-shore.

- Companies providing products or services must look as if they can provide continuity of service well into the future. Large corporations will not buy a product produced by a University professor in his basement.

- Product packaging, support services and marketing must all be sufficient to convince a buyer that this product will compete with any others available in the world. A courseware registry or exchange, while potentially very important for the public education sector, has very little relevance in Commercial Training.

- A great deal of market research needs to be done as part of this initiative to confirm that: (a) a sufficient market really exists for commercial C.A.L.; and (b) exactly what is required by the market and how it can be serviced.

- This is complicated by the fact that most potential buyers of these products and services will need considerable education before they can articulate their needs and become potential clients. Most Training Managers do not have a clear picture of the potential role of C.A.L. in their in-company training programs nor do they have any idea of which technical alternatives are likely to best satisfy their needs. They are often sold inappropriate or ineffective products (usually from the U.S.) or they simply defer the decision on C.A.L. for as long as possible. I think this initiative could benefit a great deal from a program to educate Training Managers about C.A.L.

I think this is a very good initiative which has real potential benefits for Canadian Education, Industry and Society. I hope that we can find a way to harness the considerable expertise which exists in Canada for the creation of first class, needed low cost products and services.

****

Manitoba Educational Technology Program

EDUCATIONAL TECHNOLOGY PROGRAM OVERVIEW

In addition to providing leadership and support in the use of technology in Manitoba schools, it is the desire of the Educational Technology Program to create an atmosphere whereby computer technology will continue to expand and thrive. The general goals of the program are to:

1. Ensure that students and educators in the K-12 schools of Manitoba have access to computer technology. The Educational Technology Program will be the link between schools and computer manufacturers, thus allowing schools access to the latest computer technology at the most favourable prices.

2. Provide support and professional development for Manitoba educators in the use of technology in the classroom. The intent is to provide educators with an expanded professional development program that will employ the latest technical information needed to integrate computers and technology into the school system.

3. To stimulate expanded courseware development by Manitoba authors and educators, to satisfy Manitoba needs and those of other markets.

The intent is to implement the Educational Technology Program in two phases. Major components of Phase I (1984-85) will be:

1. Establishment of a Distributive Network for Manitoba Schools. This network will allow schools to connect micro-computers to central computer system(s) for functions such as: data base access; courseware access; computer language access; administrative applications; file storage; and electronic mail.

   Access to the network will be available to all Manitoba schools. Costs relative to the use of the distributive network will be shared between participating schools and the Educational Technology Program.

2. Establishment of a Resource Centre. Equipped with the most recent computer technology, courseware and support staff, the Resource Centre will become the focal point of the Educational Technology Program. The Centre will function as a:

   (a) Walk-in centre for educators interested in exploring the use of educational technology.

   (b) Professional development facility where educators can attend workshops, seminars and short courses.

   (c) Courseware Preview Centre where educators can examine courseware.

   (d) Consultative support facility where educators can obtain educational computing curriculum, technical information and advice.

3. Consultative Support. Another major benefit to the school system is to expand the existing resource base in order to provide increased consultative support to Manitoba's Computer Education curricula (Computer Awareness K-3/4-6/7-9, Computer Awareness 105 Data Processing 202/302 and Computer Science 205/305). By June 1984, all phases of Computer Education curricula will be completed and interim guides are expected to be mailed to all schools by Fall of 1984.

4. Establishment of Centralized Hardware Purchasing. Contracts with major hardware manufacturers are being negotiated in order to take advantage of volume purchasing. Further details are to be released in June 1984.

Initiatives planned for Phase II (1985-86) of the Educational Technology Program, with further details to be provided at a later date, expand Phase I to include:

1. A program to stimulate and initiate courseware development in Manitoba. This thrust is designed to encourage the establishment of a courseware industry in Manitoba.

2. Consultative support towards increasing the use of technology and courseware into such disciplines as Language Arts, Mathematics, Science and Social Studies.

3. A research component that will investigate and field test new technologies as applicable to education.

4. Agreements between courseware suppliers for the distribution of quality courseware to schools in Manitoba and abroad.

****

Interprovincial Association for Telidon and Telematics

Given that the educational and training sector represents at least 40 billion dollars per year in Canada and that a minimum of 10% of this activity is moving in a high technology direction, we strongly support the recommendations of ACIT in regard to the development of a Canadian Computer Assisted Learning industry.

This development should support an educational environment in which the curriculum is balanced in regard to arts, sciences, fine arts and practical training, where the social nature of the learning process is emphasized, and where full equality of access to information and learning is paramount. Native people, women, the handicapped, adult learners, and both official language groups must be included in this process. The emphasis on Canadian content detailed in the attached policy of the Canadian Teachers' Federation ought to be accepted as a basic set of premises.

The existing base of teacher expertise must be strengthened by innovative in-service and educational leave programs.

Canada has the opportunity to become a centre of excellence in CAL, as evidenced by research and development and pilot projects underway in many provinces and federally-sponsored programs.

A centre of excellence will be judged in part by the society's ability to deliver education to all groups, whatever their location, in an equitable manner. We stress, therefore, the requirement for low-cost telecommunication rates for delivery of educational materials.

Canada's respected position in the world community stems largely from an atmosphere which encourages and supports creativity and innovation. While the emphasis on standards and policy is necessary and appropriate in development and production, encouragement and support for diversity and innovation in research is critical to maintaining a momentum and position in future world markets. A strategy of directed expansion would help the sector reach its goals and bring not only economic but social benefits.

We affirm that the private and public sectors can cooperate and suggest that government aid be directed to Canadian-authored CAL materials produced by Canadian-owned firms and institutions so that their full potential to create jobs by generating exports and replacing imports is fulfilled. We encourage government initiatives in this area.

Activity in this area is crucial to the education of the coming generation. We urge the NRC to expand its own activities and we offer IPATT's support in the complex coordination and consultation that will be required.

CANADIAN TEACHERS' FEDERATION

FÉDÉRATION CANADIENNE DES ENSEIGNANTS

Attachment to IPATT Submission

SECRETARY GENERAL, DR. STIRLING McDOWELL, SECRÉTAIRE GÉNÉRAL • 110 ARGYLE, OTTAWA, ONTARIO • K2P 1B4 • 613-233-1506
CABLE: CANTEACH, OTTAWA TELEX NO.: 053-4459

CANADIAN TEACHERS' FEDERATION

POLICY ON

CANADIAN CONTENT IN LEARNING MATERIALS

1. Definition of Learning Materials that are Canadian

1.1 Where practical, Canadian content should be an integral part of learning materials in all subject areas.

1.2 Learning materials should reflect the historic and contemporary roles of both men and women and of Canada's two official linguistic groups and its multicultural nature. Learning materials should also reflect the historic and contemporary roles of Canadian native peoples.

1.3 Local and provincial/territorial education authorities should keep Canadian publishers and computer courseware producers informed of planned curriculum changes on a regular basis, by a mutually determined system; and the implementation of new curricula at the classroom level should be coordinated with the development, publication and dissemination of appropriate learning materials.

1.4 Publishers should address the need for a range of materials which will respond to curriculum guidelines and the learning requirements of the variety of students attending publicly funded and administered elementary and secondary schools in Canada.

2. Problems of Availability of Canadian Learning Materials

2.1 Interprovincial/territorial sharing of materials produced at local and provincial levels should be organized and the Canada Studies Foundation should be invited to initiate and direct this sharing and to seek the cooperation of CTF, CSTA and CMEC and, through them, the Members of these organizations.

2.2 Federal and provincial support should be available to francophones in every province to assist them in developing and disseminating Canadian francophone learning materials within each province and territory as well as nationally. In addition, federal and provincial support should be available to the anglophone minority in Quebec to assist them in developing and disseminating Canadian anglophone learning materials.

2. Problems of Availability of Canadian Learning Materials (continued)

2.3 The National Film Board should be recognized as a producer of valuable cultural and educational materials and be given adequate financial support to produce and distribute such materials for school use, in both official languages.

2.4 The National Film Board Advisory Committee on Educational Materials should be reconstituted.

2.5 The production of National Film Board education materials which serve small markets should be subsidized by the federal government and provincial/territorial education authorities.

2.6 Publishers should produce and disseminate attractive, informative and interesting catalogues of Canadian materials available for teacher use, and should seek ways to bring these catalogues to the attention of all teachers.

2.7 A centralized computerized data bank listing descriptions of Canadian materials and information about their availability should be developed for use in videotex systems such as Telidon.

2.8 A federal grant program should be established for teachers to encourage them to develop pedagogical materials oriented towards the needs of specific communities.

3. Support for the Production of Learning Materials in Canada

3.1 Financial support should be given by federal agencies such as the Secretary of State, Minister of State for Multiculturalism, Department of Indian and Northern Affairs and the Department of Communications to minority groups for research, development and dissemination of learning materials that support minority and regional cultures and discuss their place in Canadian society.

3.2 Federal government departments should make resources and funding available for the development and production of Canadian materials with small market potential where private interests cannot or will not attempt to do so.

3.3 The publication of Canadian learning materials should be encouraged by the award of federal and provincial grants to Canadian authors of educational materials for elementary and secondary schools.

3.4 Each of the following agencies should be urged to strengthen its role in promoting Canadian content of educational materials in both official languages: the National Film Board, CBC, Radio Canada.

3.5 The purchasing policies of education institutions should ensure that Canadian materials receive priority treatment.

3. Support for the Production of Learning Materials in Canada (continued)

3.6 University professors should include Canadian content in their research, studies and work, particularly where this work could eventually influence or be part of elementary-secondary learning materials.

4. New Technology and Canadian Learning Materials

4.1 Communication technology should be used to ensure equal access to education for students living in all parts of Canada.

4.2 Communication technology should be available in both official languages.

4.3 The Council of Ministers of Education should encourage and financially support:

a) further research on the potential educational applications of research in communications technology;

b) the efforts of educational associations to promote greater interprovincial consultation and cooperation in the sharing of information about communication technology;

c) the development and adoption of technical standards to promote compatibility of courseware, software and hardware used in education in Canada.

4.4 The Council of Ministers, federal and provincial governments, and universities should undertake research on the probable impact of new technologies on teaching and on the quality of education received by Canadian students.

4.5 Federal and provincial governments should inform the education community, on a regular basis, of the types of communication networks and data bases they will be making available.

4.6 Governments should identify clearly which department or departments will be responsible for financial support of the development of education-based courseware and software.

4.7 Canadian publishers should be encouraged to branch out into the production of courseware to serve the Canadian market.

4.8 University Faculties of Education should ensure that professors of education who are directly involved in teaching courses in the use of new computer and communications technology are fully aware of the need for continued support for Canadian content.

5. Copyright

5.1 The federal government should promptly revise its copyright legislation to recognize the needs of both authors and users of Canadian learning materials.

5.2 The work of authors of computer coursewar[illegible] produced for use in education should be acknowledged by payment commensurate with the labour involved and anticipated use, upon the completed authorship of the works, and no further royalty payments be made.

5.3 The federal government should revise the copyright law to make it applicable to all new technologies including the use of videodiscs and micro-computer and Telidon software.

6. Federal Responsibility for Policy Development and Regulatory Actions

6.1 Regulatory agencies and governments should be encouraged to include the following features in regulations pertaining to new communications technology:

a) ready public access at a reasonable cost to any telecommunication system, including those used in education;

b) inexpensive and ready public access to "public" information, to be available in both official languages;

c) Canadian content in public data bases.

6.2 Governments should move immediately towards the early establishment of a Telematic Information Policy, which would promote:

a) a strong indigenous capability to produce content for domestic needs and to actively market our products;

b) the establishment of common standards for the production of system software, appropriate to each official language;

c) the participation in manufacture, production and design of software and content by all regions in Canada;

d) equality of access by all regions and both official language groups.

6.3 The federal government should act immediately to provide financial support for the development of a set of bilingual on-line data bases.

THE MICROCOMPUTERS DEVELOPMENT PLAN PROPOSED BY THE QUEBEC DEPARTMENT OF EDUCATION

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In July, the Quebec Department of Education (MEQ) submitted to its partners a fifty-page document detailing a five-year plan to develop the use of microcomputers in educational institutions throughout Quebec. I will outline this plan, describing the **context** in which it has evolved, the **objectives** it seeks to achieve, the **measures** it proposes to implement, and the **progress** made since July.

Context

The proposed plan must be considered both within the general context of technological change, and within the more specific context of initiatives already under way, other provincial policies, and the economic situation in Quebec.

The shift to microcomputing is no longer merely a technological and commercial phenomenon, as it was in 1979-80. Today, in 1983, it has become a social, cultural and economic phenomenon which has begun to reshape industrialized societies. Furthermore, technological progress has considerably accelerated the rate of societal changes which we must all face. It was in this general context that the Government of Quebec, like others before it, decided to reassess its priorities and redirect various policies in order to firmly commit itself to this technological conversion.

Quebec educational institutions are not novices in the use of computers. On the contrary, they have undertaken numerous initiatives in this field over the past decade or so, the results of which have served as a basis for our proposal.

However, the plan coincides with other large-scale policies being implemented by MEQ, namely, new curricula, academic restructuring, occupational training for youth, and adult education. Furthermore, because of current budgetary restraints, we cannot expect considerable supplementary funding.

The microcomputers development plan thus constitutes a major challenge for Quebec. In order to meet this challenge, we need the support and dynamism of the educational institutions, and the co-operation of our partners. Obviously, individual ingenuity and a collective willingness to solve problems along the way are also essential factors in the success of this plan.

Objectives

The purpose of the plan is to prepare the education clientele for the new society currently being shaped by microcomputing.

At the elementary school level, the objectives are to enable students to 1) familiarize themselves with the computer, 2) appreciate the creative uses of the computer in individual or group projects, 3) periodically use the computer as a learning aid.

At the secondary school level, the aim is to enable students in both basic education and occupational training to 1) gain a more in-depth knowledge of the computer and its uses, languages and logical reasoning, 2) acquire an overall understanding of technological changes and data processing applications, 3) use the computer as a learning aid.

An additional aim for occupational training students is to ensure that they acquire basic computer skills applicable to their future field of activity.

At the college level, the objectives are to 1) encourage the use of the computer as an educational tool and as a learning aid in the various disciplines, 2) train all students in the various occupational training programs to use the computer as a work tool.

At the university level, the aims of the plan are to 1) allow students to exercise their analytical and creative skills in using the computer, in particular through increased access to data banks, 2) train students in the use of the appropriate technology for their studies, their research and the practice of their professions.

Another aim of the plan is to supplement the education of certain groups, for instance, by using computers as a means of enabling slower students to catch up or providing more advanced students with enrichment activities.

Measures

In order to achieve these objectives, MEQ proposes to implement measures in six different areas: curricula; staff training and development; software and courseware production; equipment acquisition; telematics and teleprocessing; and research, development and innovation.

Curricula

The development of microcomputing in education requires that certain curricula be updated. This year, MEQ will implement an

introductory computer science program at levels IV and V of the secondary school system. Existing occupational training programs in both secondary schools and colleges will be revised so as to allow for the integration of computer equipment. At the university level, programs must be better adapted to technological change, and new programs in educational technology must be introduced. The plan also proposes that computers be integrated into teacher training programs, and that instruction be given in the various classroom uses of the computer.

Not all curricula will undergo major modifications, but most will be affected to some extent by the use of computers. MEQ will therefore prepare teachers' manuals on the educational uses of the computer.

Staff Training and Development

The success of initiatives to develop the use of microcomputers in the classroom depends largely on teaching and other staff in educational institutions. For this reason, staff training and development are the pivot of the plan.

Since training needs are numerous and vary according to clientele, several programs have been proposed.

1. A general computer awareness program will be established to highlight initiatives already under way in the electronic and print media. In the context of this program, MEQ will provide its networks with detailed information through written documents and audiovisual presentations.

2. An introduction and initiation program, lasting 2 to 3 days, will be offered to all educators. This program will be the responsibility of the various educational institutions, and could be offered on professional development days. The purpose of the program is to provide a basic introduction to microcomputing, mainly through a series of televised courses produced jointly by MEQ and the Ontario Ministry of Education. The course material includes 24 half-hour telecasts designed to familiarize viewers with the computer and its uses. Similar training is available to interested executives and managers through the Ecole nationale d'administration publique, which holds intensive sessions of the same duration.

3. A lighter training program, lasting from 30 to 45 hours, will be established for school and CEGEP staff wishing to use the computer for teaching purposes. This program is designed to provide a basic knowledge of the computer and its classroom uses. Intensive sessions seem most suitable

for this type of training. The various educational institutions will be responsible for co-ordinating the program, with the assistance of the plan's promotional agents or the resources of universities or other educational institutions. MEQ will prepare the necessary teaching materials.

4. A comprehensive training program, lasting approximately 180 hours and spread over several months, will be offered to secondary school teachers in charge of the introductory computer science program, and to teachers designated promotional agents in the various institutions. Universities will be responsible for providing this training, while MEQ will provide course content and teaching materials.

5. Practical training programs in industry are planned for occupational training instructors. The objectives of these programs will vary according to the field of specialization, but their purpose will be the same: to provide these instructors with a functional understanding of new technology specific to their field, and developed and used in the workplace.

Additional training programs will be required, mainly in universities. MEQ's commitment to these initiatives is reflected in the proposed development plan.

At the end of the five-year period provided for in the action plan, 4000 teachers will have completed the 2-day initiation program, 800 ISI course instructors and 230 promotional agents will have completed the comprehensive training program, and 100 college instructors will have completed training periods in industry.

Financing for these activities will come from three main sources: supplementary budgets, provincial and local training budgets, and MEQ, which will provide, in particular, the necessary teaching materials. The following figures give an indication of the resources which can be directed toward these activities: the 1983-84 school board budget is approximately $8,000,000, and the CEGEP budget is $1,825,000; at least 50% of these amounts can be allocated as deemed appropriate by the respective institutions. MEQ will contribute between $400,000 and $500,000 in teaching materials, and will provide additional resources of necessary, after consultation with the Quebec Treasury Board.

Software and Courseware Development and Production

Software and courseware production is an essential part of MEQ's plan, especially in view of Quebec's linguistic situation.

It is difficult to accurately determine the needs of the educational system in this area - although we can assume that these needs will increase over the five-year period. In fact, the need for teachers and students to master the computer may initially take precedence over courseware requirements.

Although the software needs of students have not yet been determined, the urgent needs of teachers are obvious. While being trained in the use of the computer, teachers will require high quality, French-language products, which provide good examples and illustrations of the various types of courseware. Furthermore, after their training, some teachers will wish to use existing courseware, while others will prefer to design their own. In either case, quality products and/or programming tools, such as author languages, will have to be provided to sustain the interest and facilitate the design work of these teachers.

The proposed strategy for software and courseware development is to appeal first to private industry in Quebec, outlining the desired specifications for educational products. We will also rely on the participation of francophone groups, and on the production capabilities of the educational networks themselves. Where neither private industry nor the educational system can ensure production, MEQ intends to assist through coproduction.

In addition, MEQ intends to take the necessary measures to ensure the identification of production and equipment requirements. This will involve establishing a programming committee consisting of representatives of the various government units concerned, informing private industry of needs and specifications, evaluating the products offered, and making known the results.

MEQ is also examining the possibility of supporting centres of excellence and product demonstration, and creating an agency which would evaluate teaching materials.

Initially, financing for software and courseware should be available under school board and CEGEP teaching materials envelopes. For 1983-84, these total $45,500,000 and $17,000,000, respectively. Additional production will be financed by educational innovation budgets, which will be increased by $1,000,000 annually to provide for a microcomputing item.

Equipment Acquisition

Acquisitions will be made over five years and will include microcomputers and specialized equipment for occupational training. Technical specifications are given in the appendix attached to the development plan. The most important of these are the requirements for 16 bits and a minimum memory of 128K.

The specifications have been established so as to satisfy the needs of both computer science instruction and educational applications of the computer. Furthermore, an attempt has been made to ensure that equipment acquired by the networks will not become technologically obsolete in the near future.

The number of acquisitions to be made was calculated on the basis of 8 machines per primary school and 8 per laboratory or centre in secondary schools. These acquisitions could be made over the five-year period as follows: 3,850 machines in 1983-84, of which 750 would be allotted to primary schools, 2,300 to secondary schools and 400 to colleges; 11,500 machines in 1984-85; 9,200 machines in 1985-86; 8,150 machines in 1986-87; and 7,500 in 1987-88. If we add to these figures the computers to be purchased for universities and the specialized equipment, we arrive at a total of 45,700 acquisitions by the end of the five-year period. The cost involved is $15.5M in 1983-84, $43.0M in 1984-85, $36.8M in 1985-86, $32.6M in 1986-87 and $30.0M in 1987-88, for a total of $156.8M.

These amounts represent a non-transferable envelope and will be paid to the educational institutions in the form of special grants. The institutions will be responsible for deciding the rate at which they acquire their equipment, on the basis of progress made in staff training and software and courseware development.

The acquisition of this equipment may have considerable economic repercussions on the province. Consequently, this area of activity is being administered jointly by the departments of Education, of Science and Technology, and of Industry, Trade and Tourism. A call for tenders is to be issued so that an umbrella agreement may be reached with one or more suppliers. We had originally intended to reach this stage by October 1983, but were delayed for reasons which will be explained later.

Purchasing decisions are fully the responsibility of the educational institutions. MEQ's role will be to encourage them to make acquisitions under the agreement, and to provide additional financial assistance if called upon to do so.

Telematics and the Telecommunications Network

Microcomputers can be used as network terminals with access to a wide range of services and data. They can also be used to generate data communications pages for input into data banks. It is therefore important to build a system which provides for these functions and will be compatible with future developments.

For the past 15 years, MEQ and the various educational institutions have been equipped with a telecommunications network linking school board and CEGEP minicomputers to a powerful central

computer, for administrative purposes. This network can be adapted so that it will access the microcomputers and satisfy teaching requirements. MEQ and its partners in the various institutions are conducting a study to determine the necessary system modifications, which will include the acquisition of concentrators and new telecommunications software.

Research, Development and Innovation

Research, development and innovation activities preceded and gave impetus to the microcomputers development plan for educational institutions. These activities must be intensified so as to provide the information necessary to the decision-making process as the plan progresses. Consequently, MEQ will encourage basic research, applied research, R & D and action research to ensure the smooth integration of the tool into the educational networks.

The plan proposes the reorientation of various existing grant programs as a means of financing these activities. However, it is understood that the innovation projects will be carried out in the educational institutions themselves, under their authority, and by their staff. We would stress making known the results as a means of inspiring other educational institutions.

Progress made since July

The microcomputers development plan was submitted to the educational institutions in July, for consultation purposes. MEQ should receive their input by the end of October, and will then be able to consolidate the overall plan.

This plan should be completed by November 15. The various educational institutions will then be asked to submit their sectorial plans by mid-December.

Therefore, this proposal should not be considered firm and final; it is a working document which will serve as a basis for discussion between MEQ and its networks.

Progress has already been made in certain areas of the plan since it was first proposed.

1. **Curricula:** The establishment of the introductory computer science course in secondary schools is well under way. Some 150 new schools have indicated their desire to offer the course in September 1983, and each will receive $16,000 for equipment acquisition. Enrolment has reached 18,000 - three times the forecast number.

   To take advantage of reduced rates on bulk orders, 20 school boards decided to make a group purchase and issued a joint

call for industry tenders. The ensuing contract resulted in the delivery of 400 IBM PCs to the institutions involved at the beginning of the school year.

It should be pointed out that the equipment purchased through this contract is not part of the equipment to be purchased by Quebec under its five-year action plan, as will be seen later.

2. **Staff training and development:** Two major initiatives were undertaken in this area under MEQ's plan.

First, the introduction and initiation program was launched, with the first of the televised "OCTO-PUCE" series being shown October 2. This series is broadcast by Radio-Québec on Sundays and Tuesdays, and is accompanied by a correspondence course prepared by MEQ. The 24 "OCTO-PUCE" telecasts, produced jointly by the governments of Quebec and Ontario, serve also to familiarize the general public with computers.

A total of $500,000 was invested in this program. The estimated enrolment in the correspondence course was 10,000; that figure was reached by the second "OCTO-PUCE" telecast. The series has been so successful that it will be shown again in January 1984.

Second, the comprehensive training program is almost ready to be launched. The course content will require six weeks of instruction and will cover four subject areas: programming languages (60 hours), the various teaching applications of computers (60 hours), the structure of the computer (30 hours), and teaching design (30 hours). The program will last 12 weeks, each week of instruction being followed by a week of practical sessions in the home institution.

A group of 30 promotional agents have been taking this course since October 11. These volunteers, recruited through MEQ's regional offices, number two per region. Fifteen are from primary schools and fifteen from secondary schools. The course, offered at UQAM, is taught by eight experienced instructors. Another training centre will be opened in Quebec City in January.

The teaching materials for this program will also be used in the lighter training program. MEQ has injected $400,000 into this activity.

3. **Equipment:** In June, MEQ organized a series of meetings with 23 Quebec, multinational and foreign firms which had shown an interest in the project, and invited their opinions on technical specifications for the equipment.

Technical specifications were drawn up on the basis of their comments, and will be presented to the firms on October 31 along with other tender documents. These documents were prepared by an interdepartmental committee with representatives of the departments of Education, of Science and Technology, and of Industry, Trade and Tourism.

Quebec firms may submit tenders directly; the three multinationals (IBM, Sperry-Univac and Burroughs) may do so on condition that their tenders provide for an association with a Quebec company; other firms may not submit tenders unless they are associated with a Quebec company.

Two other strict requirements must be met: the equipment produced must have at least 50% Quebec content (hardware and software) upon leaving the factory and 80% to 90% Quebec content two years after implementation of the plan, and Quebec must have at least 50% ownership in associations between firms.

The call for tenders will be closed in mid-December, and the government hopes to sign an umbrella agreement with one or two suppliers toward the end of January. The educational institutions could thus begin acquiring equipment in the spring.

4. **Software and courseware:** Several commitees are now meeting to smooth out certain points in the plan, namely, copy right, the use of French, centres of excellence and product demonstration, and overall planning and co-ordination. Specifications will soon be submitted to private industry for the production of software and courseware.

5. **Financing:** A request was submitted to the provincial Treasury Board for $9.4M in additional funding to increase the current envelope with regard to software and courseware ($6.7M), research and testing ($1.9M) and occupational training ($800,000). Under the capital budget, $45.0M is requested for equipment and $350,000 for the telecommunications network. These funds should be available in the 1984-85 fiscal year.

By proposing this plan to its networks, MEQ hopes to involve them in a major teaching and technological revolution. Knowing that the proposal may have economic spinoffs and wishing to maximize these, MEQ created in September the Société d'exportation des ressources éducatives québécoises (Quebec educational resources export corporation). SEREQ will provide liaison between customers requesting educational services or products and Quebec suppliers. Through SEREQ, MEQ hopes to extend the activities described in its plan to the international market.

Conclusion

As can be seen from the foregoing, MEQ's plan will set in motion a very large-scale operation. Based on the experiences of other countries and provinces, we are confident that the plan will succeed and that it will enable us to make our youth computer-literate.

The educational system is known for its tendency to resist change. Nevertheless, we believe that the microcomputers development plan contains all the necessary ingredients to ensure rapid collective learning within this system and that the end result will be of considerable benefit to our society in general.

COMPUTERS IN EDUCATION - ONTARIO INITIATIVES

Lorne R. Smith

Ontario Ministry of Education

On March 24, 1983 the Honourable Bette Stephenson announced an overall strategy to apply microelectronics to Ontario schools in ways which support the goals and objectives for education in Ontario. The elements of this strategy are:

1. Release of functional requirements for microcomputers which will allow students to make use of the capabilities of second and third generation microcomputers;

2. Standardization of the programming languages and other key features so that newly-produced softwares will run on all microcomputers meeting the Ontario requirements and will be portable from generation to generation of equipment;

3. Creation of support programs which will build on the considerable software development expertise in the province and help teachers, researchers, software specialists, media producers, publishers and software houses to form a viable commercial industry to supply the educational software needs in Ontario;

4. Assistance to school boards in acquiring and applying microcomputers in appropriate ways so that a basis is created for developing computer literacy;

5. Upgrading and extending the range of Computer Studies in Ontario schools;

6. Release of a guide for use by school boards in planning the introduction of microcomputers to schools.

Background

Early in 1981 the Ministry of Education established a Computers in Education Project Group by seconding personnel from various branches. At the same time a 22-person Provincial Advisory Committee on Computers in Education was formed to advise the Ministry on the policy issues related to the introduction of microcomputers into schools.

This Committee submitted its final report containing 29 recommendations to the Ministry in July 1983. During this crucial two year study period, a number of projects were initiated:

- 6 pilot schools were studied;
- 57 exemplar Lessonware Projects were funded ;
- A lessonware evaluation guide was developed;
- 2 important research projects were undertaken;
- A regional network of experienced educators involved with microcomputers was established;
- Studies were undertaken to identify functional requirements for microcomputers to be used in schools.

This activity culminated in the release on March 24, 1983 of a series of official memoranda which outlined a comprehensive plan to introduce microcomputers into Ontario schools. This plan contains the following elements.

1. Funding of School Board Purchase of Microcomputers

As of January 1, 1984 school board purchases of microcomputers and microcomputer systems designated by the Ministry of Education as meeting specific requirements, will be recognized under the General Legislative Grant Plan as extraordinary expenditure at the board's first rate of grant.

This recognition means that such purchases will not be affected, in terms of grant eligibility, by the board's ceiling on ordinary expenditure, and will receive a rate of grant which on the average across the Province, is approximately 75%.

The Functional Requirements for Microcomputers for Educational Use, Stage I cannot be seen as definitive. They will be revised and updated to reflect new capabilities as they become available. These requirements are based on the Ontario Curriculum policy which stresses the autonomy of the individual learner. The computer should, therefore, be an aid to the individual learning tasks the student encounters and be readily available in every classroom whenever the need arises.

The Ministry believes, therefore, that the optimal use of microcomputers in schools will be in small classroom clusters of microcomputers connected by a local network to a central nodal point at which there will be concentrations of electro-mechanical devices such as printers and disc drives, the networking electronics and sufficient local memory to store the individual working files of the students and the software programs they may be using, as well as interconnect arrangements to external networks and data sources.

The network should be expandable to thirty or more microcomputers either in different classrooms or in a single 'computer laboratory' for instruction in formal computer science. The microcomputers, whether in a network or stand-alone mode, should be powerful computers in their own right, with sufficient local memory to fully sustain a student's individual work plan independently of other users. The network should permit a mix of microcomputers of different powers, and a variety of video display terminals to match the mix of computing tasks which will evolve in each classroom.

In order to standardize the programming languages available to the students, the Waterloo Systems languages must be available on all machines. In addition, an overall requirement is for state-of-the-art technology, including 16 and/or 32 bit processors, voice synthesis and trackball or mouse interface.

2. Acquisition of these Second Generation Microcomputers

The Ministry of Education and the Ministry of Industry and Trade worked together to bring about the formation of a new Canadian company whose major corporate objective is to design and manufacture computers for the educational market place. This market place has been peripheral to the objectives of most existing companies and it was felt that a significant industrial development opportunity was open to a company prepared to make the educational market its primary objective.

The Ministry of Education has entered into a contract to purchase from the Canadian Educational Microprocessor Corporation (CEMCorp) microcomputer systems which meet the Ministry's functional requirements to a total value of ten million dollars, for distribution to Ontario school boards. These orders will consist of two million dollars worth of prototype systems, deliverable in the summer and fall of 1983, and eight million dollars worth of fully developed systems deliverable in late 1983 and throughout 1984, together with the necessary systems software. The prototype systems will be pilot tested in Ontario classrooms and will become the property gratis of school boards providing testing facilities. The fully developed or 'commercial' systems will be made available to school boards at a cost which is 25% of the manufacturers contracted price. The computer systems being developed by CEMCorp will be fully consistent with the Ministry's functional requirements. The systems covered by the Ministry's purchase agreement will be based on the following elements:

- A "Standard Student Microcomputer" based on a 16 bit electronic architecture with 128K of random access memory (expandable to 256K);
- An "Advanced Student Microcomputer" based on 32 bit electronic architecture with 256K of random access memory, expandable to 1024K (available in fall of 1984);
- A "Fileserver" acting as a central storage facility for software, (languages and sophisticated user interface) student personal storage and a classroom management information, which contains a floppy disc drive, a hard disc drive, 256K of random access memory, networking electronics, and ports for connection to printers, other peripherals and external networks;
- A local area network including power and network cabling modules linking up to thirty-two, standard and/or advanced microcomputers with the fileserver;
- 12" monochrome, 15" high resolution monochrome or 13" colour video displays.

3. Educational Software for Ontario Schools

It is essential that Ontario schools take full advantage of the contribution to learning that quality educational software can provide.

This cannot happen unless lessonware and courseware which is expertly developed, in both the pedagogical and technical sense, and directly relevant to the learning objectives in Ontario curriculum guidelines, becomes widely available. For this reason, the Ministry of Education and the Ministry of Industry and Trade have collaborated with BILD - the Board of Industrial Leadership and Development - to institute the following series of measures to assist the growth of an Ontario educational software industry.

- An advisory body of representatives of the educational client groups and the educational software industry will be established to advise on the priorities to be observed in developing materials and the further development of the supporting program and policies of the Ministries;
- A process to identify and prioritize educational software needs will be established;
- A program of developmental grants to educational software producers will be instituted;
- The 'Crown in right of Ontario will purchase licenses from educational software producers which will allow free and unrestricted use of materials in Ontario educational institutions but which will leave rights in other Ontario markets and in other jurisdictions, in the hands of the producers;
- Provision of technical and pedagogical advisory services for software producers.
- Provision will be made within the Ministries to identify potential producers, to develop evaluative criteria for assessing developmental proposals, purchasing licenses and accepting materials for cataloguing and distribution, to fund ongoing research, to integrate software needs with Ministry program development plans, and to affect general cooperation;
- The Ontario Educational Communications Authority will assume responsibility for establishing a cataloguing and dissemination service for Canadian educational software which meet the Ministries' evaluative criteria.

To initiate these programs, BILD funds have been provided totalling $1.3 million in 1983, $5.46 million in 1984, and growing to $10 million per year by 1986. These measures are designed to provide a supportive infrastructure within which a private Canadian industry can develop to supply in large measure the educational software needs of Ontario schools.

4. Computer Studies Curriculum Guidelines

A new curriculum guideline for Computer Studies, setting out policy for the development of courses related to computers in grades 10, 11 and 12, has been released. Copies of the documents were distributed to all schools in June 1983 to provide a resource for curriculum development teams and educators who wished to plan changes in current courses and design pilot courses to begin this fall.

Beginning September 1984, all Computer Studies courses must be based on this guideline which supercedes Curriculum RP33: Data Processing, 1966; Elements of Computer Technology, 1970; Computer Science Senior Division, 1970; and Informatics, Intermediate and Senior Division, 1972. This new guideline has been under development over the last two years and has been validated by a wide range of educators across the province, computer specialists and members of the Canadian "high tech" industry. It will provide for a wide variety of courses in computer technology, programming, information processing, and systems analysis and design to meet the varying needs and interests of students. Schools will be able to create alternate educational pathways for students who may wish to focus on job skills, life skills or academic endeavours. Related guidelines such as Ontario Academic Courses in Computer Studies and Computer Technology will permit the development of complementary courses to enhance these pathways.

5. Exemplar Learning Materials Project

It is widely acknowledged that quality educational software is essential if students are to derive the maximum benefit from the new computer technologies which are emerging. The Government of Ontario considers that the need for educational software can be best met if a domestic educational software industry comes into being, uniting the talents of teachers, software specialists, educational theorists and private entrepreneurs. Such an industry, if solidly established in the Ontario domestic market, could have considerable growth potential and constitute a significant avenue for industrial development.

As a preliminary step, the Exemplary Learning Materials Project was established in order to identify individuals and companies interested in, and capable of developing a range of educational software directly related to the learning objectives in Ministry of Education curriculum guidelines and exemplary of current practice.

In recognition of the industrial development potential, funds for this project were provided by BILD. In response to a call for proposals released in March 1982, approximately 510 project proposals were received. Teachers and computer experts were used to evaluate these proposals against three criteria:

- excellence of instructional design,
- relevance to objectives in Ministry curriculum guidelines, and
- effective use of the computer.

Fifty-seven specific lessonware projects were selected for funding. The development of each of these projects is taking place in three stages: design, prototype and production, with an extensive evaluation, both technical and paedagogical, at each stage. Successful completion of one phase is required for continuation to the next.

It is expected that the resulting body of lessonware will illustrate the current state-of-the-art as envisaged by Ontario educators and software producers interested in this field. The terms of the development agreement provide the Ministry of Education with a licence for unrestricted use by Ontario school boards of these materials without additional cost or infringement of copyright.

6. Guide for Planning at the School Board Level

It is essential that all school boards develop an effective plan for the introduction of microcomputers into classrooms if the learning potential of the new technology is to be fully realized. School boards should address the following issues when preparing these plans:

- Educational objectives for the use of microcomputers
- Focus and content of the curriculum
- Nature of computer equipment required
- Administrative support services
- Implementation strategies and in-service requirements
- Resource requirements: human, time, money

7. Other Initiatives

A number of other initiatives have been undertaken to explore the potential for the use of technology in education:

Alternate Delivery System: A joint venture involving TVOntario, Correspondence Education Branch, Lake Superior Board of Education and the Computers in Education Project to establish effective ways to deliver courses electronically to isolated students is underway.

Courses in Grade 13 Physics and Basic Electronics are being provided this year. Electronics is being expanded into four full courses.

Telidon: The Ministry has been working closely with TVOntario in the creation and delivery of an Educational Telidon database consisting of over 22,000 Telidon pages, including much of the Student Guidance Information System (SGIS). A province- wide network of approximately 100 terminals has been installed in schools, Ontario Youth Centres and public libraries to evaluate the effectiveness of videotex systems in delivering youth-oriented and other types of educational information.

Research: Two important research projects are currently underway: Dr. S. Larter of the Board of Education for the City of Toronto is investigating the use of technology and teacher practice in Toronto schools to identify possible themes and/or relationships. Dr. D. Burnett of Queen's University in Kingston is investigating the creative use of microcomputers, including LOGO.

Final Report of the Provincial Advisory Committee on Computers in Education: This report, submitted in July 1983 makes recommendations in five broad areas: Curriculum and the Computer, Teacher Training, Software Development, Hardware Information Networks and Research.

Conclusion

These initiatives have been undertaken by the Government of Ontario in the belief that the nature of the educational process will be increasingly affected by the new microelectronics and communication technologies. The wide availability of quality software and hardware and the corresponding support services are essential if Ontario students are to obtain the maximum educational benefits of these technological advancements.

These initiatives, by building on the experience to date, will provide the framework within which Ontario schools and teachers can co-operate with private industry to provide the necessary learning materials to significantly enhance the learning of students.

ALBERTA EDUCATION'S COMPUTER TECHNOLOGY PROJECT

Jim Thiessen

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A. Introduction

In October, 1981, the Honorable David King announced the establishment of the Computer Technology Project. This activity was initiated to: establish an Office of Educational Technology within the Department; announce the establishment of a basic computer hardware standard for educational computing; begin an educational software clearinghouse; coordinate and deliver orientation and inservice seminars for educators; administer the activities of the Minister's Task Force on Computers in Schools; maintain an awareness of developments in the technological field as they relate to computers and schools; collaborate with other interested provincial departments of education in various educational computing activities; and conduct or fund research and evaluation activities within Alberta.

B. Implementation

Now, almost two years later, the Computer Technology Project has been fully operational for about eighteen months. Staff members have been hired, space has been allocated, contacts with other departments of education have been established, the Task Force has made it's final report to the Minister, some research and evaluation studies have been carried out or are underway, a computer literacy curriculum at the elementary level is being implemented this fall, and the junior and senior high computer literacy curricula are being piloted at the present time.

I would like to briefly describe the rationale for some specific policies, and to briefly present the Task Force's perceptions of the future.

C. Office of Educational Technology

The Computer Technology Project staff consists of a total of seven people. Six occupy project positions. We also have seconded a classroom teacher to provide assistance in courseware screening and evaluation.

The work is divided into a number of areas. Our Inservice Manager is responsible for the planning and coordinating of computer inservice activities for Alberta Education. A number of microcomputers have been made available for use at the workshops, and so delivery of these seminars is dependent only upon the availability of time and space.

The other major area is the Clearinghouse. The Manager of the Clearinghouse is responsible for searching, ordering, screening, and evaluating the courseware materials. After evaluation is complete, his responsibility is to communicate the results to the field.

The Project Director and the two managers administer the Project's activities, including familiarization with new developments in the technological and software development areas. Communicating information to others means publishing a number of documents, including a tabloid that appears quarterly, and regular reports of courseware evaluation results. We serve on departmental committees involved in the development of the computer literacy curricula, and other such committees as needed.

D. Hardware Standard

Prior to the announcement of the Project, Alberta educators were making numerous inquiries to Alberta Education personnel regarding the appropriate microcomputer hardware which school systems should buy. Frequently, the person requesting the information wondered whether Alberta Education was planning to make a policy decision regarding this matter. Because provincial governments have responsibility for curriculum content, and because the educational software comprises a substantial learning resource, administrators needed this kind of information prior to investing their scarce resources in computers.

Since 1979, when Alberta Education funded a number of research projects related to the use of computers in schools, I had been named the liaison officer for studies related to computers in education. Part of my activities involved becoming familiar with microcomputer developments, with a view toward preparation of policy recommendations regarding these innovations.

Many discussions were held with fellow Alberta Education personnel, university experts, classroom teachers, school district administrators and trustees, data processing professionals, and hardware and software manufacturers. A number of issues became apparent.

For example, if no microcomputer hardware standardization were to occur, what would happen? Experience in other school jurisdictions suggested that educational software, also called courseware, would not be as readily available for some computers as it was for others. Some computers would not stand up to classroom use as well as some different brands. If a school system invested in a particular brand of computer, and the company manufacturing those computers brought out a new version, or a new model of the computer, without making the new model compatible with the old one, all of the money invested in courseware could be wasted. Buying the same courseware for new versions of the same microcomputer would not be a wise use of public funds.

Of course, another major issue is for what purpose are these computers intended? Computer literacy for teachers and students is obvious, because computerization will influence North American lives to a greater and greater extent during the next decades. There are a large number of applications, both instructional and administrative, that also are important.

Computer-assisted-instruction is one. Using the power and data storage capacity of the computer to guide students through a learning sequence is a natural application of this technology. Of course, computers need some instructions to do this properly, and therefore the program availability is important.

Another application in schools is to manage the instructional or learning steps. Computer-managed-learning is closely related to administrative applications. Student records, marks, planning instructional sequences, testing, review programs, and data base management are important functions for a CML program.

School building administrative applications were also considered, but in thinking about standardization this area was not viewed as being as important as computer literacy and CAI. Given the way the decision went has led to many principals using Apple computers for keeping their records and using them for administrative activities.

After the initial data was finally gathered, it became apparent that there were not that many computers from which to select. In all the North American jurisdictions that had the opportunity to standardize, only about ten had done so. We checked with them regarding their experiences, and noted their perceptions of advantages and disadvantages of making such a decision.

Finally, a decision to standardize on Apple II+ format was made. Basically, this brand was chosen because: there was more educational software available in Apple II+ format than all the other brands of microcomputers combined; this model had been used in schools for about two years, and the majority of experiences with it were positive; service for the hardware was readily available; although slightly more expensive than some of the other brands on the market, the fact that two different companies would be able to bid on the contract implied some element of competition for the business; the senior management of the computer manufacturing company was committed to upward-compatibility of software for new models of the Apple II; and no other brand of computer could match all of those characteristics.

Alberta Education did not direct school districts to purchase any particular brand of microcomputer. What was stated was that all of Alberta Education's courseware evaluation efforts were going to be directed at the Apple II+ brand, but school administrators were free to select what ever kind of computer they wanted to have. The result is that Apple II+/e's comprise approximately 60 percent of the computers in our schools.

Bids for one thousand Apple II+ computer were sought, and the successful bidder was Bell and Howell. The EduMod's were ordered and were then re-sold to Alberta school districts at the same price that Alberta Education paid for them. Within a year, all the computers were being used throughout Alberta schools.

We continue to review our decision, but until we have completed more courseware evaluations, there is little likelihood of changing that policy decision.

E. Clearinghouse

Our approach to the issue of quality educational software is to investigate the present availability of programs, to evaluate them for technical and educational value as well as applicability to the Alberta curriculum, and then we will determine in what areas educational software development is needed.

The operation of the Clearinghouse began with the hiring of a manager in the summer of 1982. Initially we searched for courseware evaluation systems already in place. Considerable credit goes to the MicroSIFT evaluation group at the Northwest Regional Educational Laboratory in Portland, Oregon for the work they have done in this area. Their director of evaluations was brought in for a series of workshops in July, 1982, to train about 40 classroom teachers to be courseware evaluators.

During the course of the subsequent few months, our evaluators and the Clearinghouse Manager decided that the evaluation process developed by MicroSIFT, and modified by the British Columbia Ministry of Education was not providing the kind of information needed by teachers and curriculum supervisors making decisions about the purchase of software. Therefore, a unique system of evaluation was developed, keeping some elements of the MicorSIFT system in place.

After the new evaluation system was developed, the teachers that had been trained initially were brought back together for further training, using this new evaluation process. During the course of this past year, almost 1,000 courseware packages have been handled. Some packages have not yet arrived from the distributor; about 100 titles are in progress at any one time; about 50 percent have been rejected, either at the screening stage or during formal evaluation; and only about ten percent have achieved any kind of official status.

Our evaluation process consists of searching for courseware in a subject area designated by the Curriculum Branch. Only Apple II+/e software is solicited. We request the publishers or distributors for an examination copy which will be used for evaluation purposes. We inform them that if their product is highly rated, it will be made available to Alberta school systems through our School Book Branch. To date, virtually every distributor has willingly complied with our request. For further details regarding the evaluation process, please refer to Dave Wighton's article "Alberta Education's Clearinghouse: Functions and Findings".

F. Inservice

Also during the summer of 1982, an Inservice Manager was hired. It has been his responsibility to coordinate the planning, development and delivery of inservice seminars for school systems requesting this service. During the initial phases of this Project, most schools did not have their own computers, so we have been able to work an arrangement with the School Book Branch for the lease of 40 Bell and Howell EduMods to take to schools for the inservice workshops.

The Inservice Manager coordinates all of these activities. Various policies have been instituted in order to make these demonstration microcomputers as accessible as possible to as many schools as we can. They are shipped around the province using almost all modes of transportation.

During this first school year, many workshops have been for teachers and administrators who were unfamiliar with microcomputers. The content of these seminars usually began with a half-day of instruction as to what a computer is and how it operates. However, specific applications, such as courseware evaluation, availability of software, administrative applications, networking, and new developments in the high tech field, are topics being requested for seminars this autumn. This suggests that those educators that have developed an interest in computing are interested in following-up their initial training.

Even though the nature of these seminars is changing, there remain many educators who still have not become familiar with the applications of computers to their field. This past summer we cooperated with the Jasper School District and ACCESS Alberta to sponsor and deliver one-week workshops in Jasper, Alberta. Teachers were able to bring their children along for the associated computer camp. These workshops were well attended in spite of very little advertising.

G. Task Force on Computers in Schools

The intent to form the Ministerial Task Force was announced at the same time as the Computer Technology Project. In July, 1982 the first meeting of the thirteen member Task Force was held, and it's report was released one year later. Members of the Task Force were drawn from all the education stakeholder groups in Alberta, such as the Alberta Teacher's Association, the Alberta School Trustee's Association, Alberta Education, Alberta Advanced Education, the Curriculum Policies Committee, the Conference of Alberta School Superintendents, representatives of post-secondary institutions such as universities, colleges, and technical institutes, two members-at-large, the data processing industry, and the Home and School Association.

During the course of the year, the Task Force met about 15 times; visited schools and related institutions in Alberta, Minnesota, Texas and California; and discussed educational computing issues with the Minister of Education and various experts brought in to attend some of the meetings. A survey of Alberta schools was done to determine the number of computers in use. In addition, a number of writing sessions were held to prepare the final draft of the report.

The Task Force made a number of recommendations to the Minister. These recommendations may be divided into a number of different categories: students and curriculum; teacher training; courseware; hardware; planning; organization; and funding.

Within the students and curriculum area, it was recommended that by 1985 all students in Alberta shall have regular access to a computer learning station. Also, a review of the Program of Studies should be initiated to introduce curriculum components related to technology, to adapt the sequence, structure and design of the Program of Studies to accommodate continuous student progress and to encourage a personalized, self-directed learning approach.

Recommendations were made regarding preservice, inservice, graduate training, and continuing education for teachers. For example, it was suggested that by 1986, all students graduating from Alberta Faculties of Education be required to have completed a computer literacy course. For teachers coming into Alberta, the Task Force recommends that a standard 40 hour computer literacy course must successfully be completed prior to certification. Also, Faculties of Education in Alberta's universities are to offer major and minor specializations in educational computing, as well as graduate programs.

Alberta Education should offer financial incentives to enable practising teachers to undertake graduate training in educational computing was also recommended.

An inservice program is to be developed and funded by Alberta Education, local jurisdictions and the teaching profession to offer every practising teacher and educational administrator in Alberta the opportunity to learn the fundamentals of educational computing. This implementation is to begin prior to the end of the 1983-84 school year.

Regarding courseware, the government was commended for the work already begun through the Clearinghouse. This work should be expanded, the Task Force suggested. The work of providing lower prices for courseware materials also should be continued. For the software development industry, the government should encourage courseware development through incentives, funding assistance, and shared research. A series of related recommendations were made to encourage copyright law revision, marketing assistance, special needs courseware development assistance, and so on.

For hardware standards, ths Task Force stated that Alberta Education ought to annually review the hardware standard already developed, and that buy-agreements be negotiated with manufacturers who meet the established hardware criteria. School jurisdictions should buy their computers from local dealers to support the business community, and to obtain better service.

With respect to educational standards, we recommend that there be one computer learning station for every eight students in a school. For Computer-Assisted-Instruction and business education applications, there should be one computer laboratory for every 8 classrooms at the junior and senior high school levels.

Alberta Education should encourage the development of network systems, and establish a central data bank to encourage and support these networks. Network standards should be developed soon to enable school systems throughout the province to communicate with each other and with centralized data bases.

It was recommended that the development of computer peripherals for handicapped students should be encouraged by Alberta Education.

Five recommendations were made relative to planning for the future. For example, Alberta Education ought to provide bold and decisive leadership in educational computing. Alberta Education should develop a comprehensive strategic provincial plan for educational computing, to be reviewed annually. Alberta Advanced Education should develop a plan to implement those recommendations that have a bearing on preservice and graduate teacher training programs. These plans are to be developed in conjunction with post-secondary institutions and this planning is to be initiated as soon as possible.

Another recommendation was that each school jurisdiction in Alberta is to develop a multi-year educational computing plan, to be reviewed and updated at least once per year. There should be an individual to coordinate the development and implementation of the educational computing plan in each school system.

A number of recommendations relative to the funding of these recommendations were made, such as the establishment of an Alberta Heritage Foundation for Educational Computing. One of the more interesting recommendations in this section is that model high-technology schools be established and jointly funded by Alberta Education and cooperating school jurisdictions.

Finally, there were some recommendations that suggest a number of organizational actions on the part of Alberta Education. The Computer Technology Project should become a permanent Branch of government was one of them. Other recommendations include the sponsorship of an annual conference to discuss issues and directions for educational computing; and the creation of advisory committees to enhance and formalize the communications process between all sectors of the educational community.

H. Related Activities

As noted in the introduction, there are a number of peripheral areas related to computers in education where the staff of the Computer Technology Project have been active.

During the past two years, a number of provincial education ministries banded together to fund a study to survey the cataloguing and indexing of computer software development and operations. This study, done by JEM Research of Victoria, British Columbia, suggested a number of policies that should be implemented in order to standardize the cataloguing systems. This would have the effect of making it relatively easy to transfer a print data base to an electronic one when the time was right. Action on this is being considered by the Council of Ministers of Education, Canada.

Research and evaluation studies were mentioned as being part of the Computer Technology Project. One of the studies that has been supported was to search for special education computer courseware materials. This was done in order to provide some assistance to Alberta Education officials who need to know where these materials may be located, and which associations and individuals are active in this area. This study is available from the Planning Services Branch, Alberta Education, Edmonton (Special Education Courseware, by John Willson of Decision Support Systems, Edmonton).

I. Summary and Conclusions

Reactions to the Task Force report have been very positive. Many school jurisdictions in Alberta have already prepared educational computing plans for their own use. A considerable number of teachers have been taking computer inservice workshops, seminars, and credit courses, and are making themselves aware of better ways to use the computer in their instructional programs.

The presence and availability of a good quality educational courseware evaluation process is an assurance that as much good quality courseware that exists will be found and the information made available to educators. To a large extent, our original goals as set out in 1981 are well established.

However, there still exists a considerable amount of work that has to be done. For example, even though we are beginning to find a greater percentage of good quality courseware packages, there is not enough. Special needs courseware is lacking, and is very costly to produce. If all students are going to have access to a computer terminal within the next few years, a considerable dollar investment will have to be made soon. Finally, if teachers are going to make efficient and effective use of the learning materials and the hardware, they will have to learn and develop the instructional techniques necessary. This will require much research and many inservice seminars and workshops.

I would like to end with a quote from the Task Force report:[1]

> Our discussion of educational computing has been guided by an abiding concern for our children and their future. Every recommendation that we have made recognizes our shared responsibility to prepare the children of Alberta for a future which will be significantly different from the present. Much of the well-being of future generations and prosperity of our province depends upon this preparation.
>
> We are on the verge of technical, economic, and educational change of an order not seen before. The question is not whether we can afford the effort and cost required to introduce computers into our schools. Rather, the question is whether we can afford NOT to do so.

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1. Computers in Schools, the report of the Minister's Task Force on Computers in Schools, Edmonton, Alberta Education, July, 1983, p.3.

Appendix 4

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